California Regional Water Quality Control Board
San Diego Region

Total Maximum Daily Loads for Indicator Bacteria in Tecolote Creek, Tributary to Mission Bay

Draft Technical Report
April, 2008

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION
9174 Sky Park Court, Suite 100, San Diego, California 92123-4340
Phone • (858) 467-2952 • Fax (858) 571-6972
http://www.waterboards.ca.gov/sandiego.

To request copies of the Basin Plan Amendment and Technical Report for Total Maximum Daily Loads for Indicator Bacteria, Tecolote Creek, please contact Ms. Amy Mecklenborg at (858) 637-7139, or by email at AMecklenborg@waterboards.ca.gov.

Documents also are available at: http://www.waterboards.ca.gov/sandiego.

Total Maximum Daily Loads for Indicator Bacteria in Tecolote Creek, Tributary to Mission Bay

Technical Report

Adopted by the
California Regional Water Quality Control Board
San Diego Region
on _______________, 200x

Approved by the
State Water Resources Control Board
on _______________, 200 x
and the
Office of Administrative Law
on _______________,200 x
and the
United States Environmental Protection Agency
on _________________. 200 x

Cover Photograph: Tecolote Creek (2007) by Amy Mecklenborg

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION
9174 Sky Park Court, Suite 100
San Diego, California 92123-4340

Telephone (858) 467-2952

This report was prepared under the direction of

David T. Barker P.E., *Chief, Water Resource Protection Branch*
Julie Chan P.G., *Chief, Water Quality Standards Unit*

by

Amy Mecklenborg, *Environmental Scientist*

with the assistance of

Wayne Chiu, P.E., *Water Resource Control Engineer*

and technical support provided by
Tetra Tech, Inc., led by Stephen Carter, P.E.

TABLE OF CONTENTS

Comment [s1]: Need to change page numbers?

APPENDICES

FIGURES

TABLES

List of Acronyms and Abbreviations

ac	Acre
AGR	Agricultural supply
ALERT	Automatic Local Evaluation in Real-Time
AQUA	Aquaculture
Basin Plan	Water Quality Control Plan for the San Diego Basin (9)
BASINS	Better Assessment Science Integrating Point and Nonpoint Sources
BIOL	Preservation of biological habitats of special significance
BMP(s)	Best Management Practice(s)
CAFOs	Concentrated animal feeding operations
Caltrans	California Department of Transportation
CAMMPR	California's Management Measures for Polluted Runoff
CASQA	California Stormwater Quality Association
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CIMIS	California Irrigation Management Information System
COLD	Cold freshwater habitat
COMM	Commercial and sport fishing
CWA	Clean Water Act
DEH	San Diego County Department of Environmental Health
DHS	Department of Health Services
EST	Estuarine habitat
EQIP	Environmental Quality Incentives Program
FRSH	Freshwater replenishment
GWR	Ground water recharge
HA	Hydrologic Area
HSA	Hydrologic Sub Area
HSPF	Hydrological Simulation Program–FORTRAN
HU	Hydrologic Unit
IND	Industrial water supply
LA	Load allocations
LAX	Los Angeles Airport
Los Angeles Water Board	California Regional Water Quality Control Board, Los Angeles Region
LSPC	Loading Simulation Program in C++
MEP	Maximum extent practicable
MAR	Marine habitat
MIGR	Migration of aquatic organisms
mL	milliliter
MM	Management measure
MOS	Margin of safety
MP	Management practice
MPN	Most probable number of bacteria colonies
MRLC	Multi-Resolution Land Characteristic

MS4	Municipal separate storm sewer systems
MUN	Municipal and domestic supply
Municipal Dischargers	Persons owning and/or operating MS4s other than Caltrans
NAV	Navigation
NCDC	National Climatic Data Center
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of intent
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint source
NRCS	Natural Resources Conservation Service
OAL	Office of Administrative Law
Ocean Plan	Water Quality Control Plan for Ocean Waters of California
POTW(s)	Publicly owned treatment work(s)
POW	Hydropower generation
PROC	Industrial process supply
RARE	Rare and endangered species
REC-1	Water contact recreation
REC-2	Non-contact water recreation
RWD	Report of waste discharge
San Diego Water Board	California Regional Water Quality Control Board, San Diego Region
SAL	Inland saline water habitat
SAG	Stakeholder Advisory Group
SANDAG	San Diego Regional Planning Agency
SCAG	Southern California Association of Governments
SCCWRP	Southern California Coastal Water Research Project
SHELL	Shellfish harvesting
SPWN	Spawning, reproduction, and/or early development
STATSGO	State soil geographic
SWRCB	State Water Resources Control Board
TBEL(s)	Technology based effluent limitation(s)
TMDL(s)	Total maximum daily load(s)
U.S.	United States
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
Waiver Policy	Basin Plan Waste Discharge Requirements Waiver Policy
WARM	Warm freshwater habitat
WDR(s)	Waste discharge requirement(s)
WILD	Wildlife habitat
WLA(s)	Wasteload allocation(s)
WQBEL(s)	Water quality based effluent limitation(s)
WQO(s)	Water quality objective(s)
WQS	Water quality standards
yr	Year

Acknowledgements

Many dedicated professionals contributed to this Technical Report through their service on the Stakeholder Advisory Group (SAG) for this indicator bacteria Total Maximum Daily Load project. The SAG provided insightful technical comments on early drafts of this report, suggested issues for technical peer review, raised important policy issues, and assisted with drafting the Implementation Plan. The California Regional Water Quality Control Board, San Diego Region, would like to thank the individuals who served on the SAG for their significant contributions to this project.

Stakeholder Advisory Group

Ed Kimura	Sierra Club
Ruth Kolb	City of San Diego
Richard Watson	California Department of Transportation
Beverly Morisako	City of San Diego
Peggy Fischer	San Diego Mesa College, Professor for Animal Health
Lauren Chico	San Diego City Unified School District

This project was funded in part by grants from the U.S. Environmental Protection Agency to provide technical support from Tetra Tech, Inc., in developing these TMDL.

Executive Summary

The purpose of this technical report is to present the development of the Total Maximum Daily Loads (TMDLs) for indicator bacteria in Tecolote Creek, which is a tributary of Mission Bay. Fecal bacteria originate from the intestinal flora of warm-blooded animals, and their presence in surface water is used as an indicator of human pathogens. Pathogens can cause illness in recreational water users. Bacteria have been historically used as indicators of human pathogens because bacteria are easier and less costly to measure than the pathogens themselves. As required by section 303(d) of the Clean Water Act (CWA), TMDLs for indicator bacteria were developed to address Tecolote Creek, which was identified as impaired for bacteria on the *2006 Clean Water Act Section 303(d) List of Water Quality Limited Segments*.

The purpose of a TMDL is to attain water quality objectives (WQOs) that support beneficial uses in the waterbody. A TMDL is defined as the sum of the individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background [40 CFR 130.2] such that the capacity of the waterbody to assimilate pollutant loading (i.e., the loading capacity) is not exceeded. Therefore, a TMDL represents the maximum amount of the pollutant of concern that the waterbody can receive and still attain water quality standards. Additionally, a TMDL represents a strategy for meeting WQOs by allocating quantitative limits for point and nonpoint pollution sources. Once this maximum pollutant amount has been calculated, it is then divided up and allocated among all of the contributing sources in the watershed.

Due to reports of high concentrations of indicator bacteria, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) placed Tecolote Creek on the *CWA Section 303(d) List of Water Quality Limited Segments* as being impaired, i.e., not meeting applicable water quality standards. Based on available water quality data, bacteria densities in Tecolote Creek have exceeded the numeric WQOs for total coliform (TC), fecal coliform (FC), and/or *Enterococcus* (ENT) indicator bacteria as defined in the San Diego Water Board's *Water Quality Control Plan for the San Diego Basin (9)* (Basin Plan). These exceedances threaten or impair the water contact (REC-1) and non-water contact (REC-2) beneficial uses of Tecolote Creek and/or Mission Bay, which is directly downstream of Tecolote Creek. TMDLs were developed to meet WQOs that support beneficial uses in these waterbodies.

Because the climate in southern California has two distinct hydrological patterns, two approaches were developed for estimating bacteria loads and calculating TMDLs. One approach used a model to estimate loading during wet weather events (storms), which tend to be episodic and short in duration, and characterized by rapid wash-off and transport of very high bacteria loads from all land use types. The other approach used available data to estimate bacteria loading during dry weather conditions, which were much smaller in magnitude than wet weather loading, did not occur from all land use types, and is more uniform than stormflow. In addition to estimating actual bacteria loading, both approaches were used to estimate TMDLs for the two climate conditions for Tecolote Creek.

A source analysis was performed to identify and quantify the sources of bacteria to Tecolote Creek. The relative bacteria loads from nonpoint and point sources can vary depending on wet or dry weather conditions. For this reason, the assessment of bacteria loads requires separate analyses for wet and dry weather conditions. Watershed and receiving water data were used to characterize the relationship between wet and dry weather conditions that are generally associated with different relative source loadings and waterbody responses.

The analysis of the relationship between pollutant loading from the identified sources and the response of the waterbody to this loading is referred to as the linkage analysis. The purpose of the linkage analysis is to quantify the maximum allowable bacteria loading that can be received by a threatened or impaired waterbody and still attain the WQOs of the applicable beneficial uses. This numeric value is, in fact, the TMDL. For this project, TMDLs were calculated for wet weather and dry weather conditions because bacteria loads differ between the two scenarios and implementation measures will be specific to wet and dry conditions.

In order to calculate TMDLs for indicator bacteria, numeric targets must be selected. Numeric targets were selected based on bacteria WQOs that support the designated beneficial uses of the waterbody (REC-1). TMDLs were calculated for each type of indicator bacteria, and for wet and dry weather.

For wet weather TMDL calculations, single sample maximum WQOs were used as numeric targets because wet weather conditions, or storm events with precipitation runoff, are episodic and short in duration, and characterized by rapid wash-off and transport of high bacteria loads, with short residence times, from all land use types to receiving waters. For dry weather TMDL calculations, geometric mean WQOs were used as numeric targets, because dry weather runoff is not generated from precipitation runoff, is not uniformly linked to every land use, and is more uniform than precipitation runoff, with lower flows, lower loads, and slower transport, making die-off and/or amplification processes more important.

Additionally, wet weather TMDLs were calculated using a “reference system approach” for an “interim” TMDL implementation phase. The reference system approach allows exceedances of the single sample WQOs for water contact recreation (REC-1) beneficial uses. The purpose of the exceedance frequency is to account for the natural and largely uncontrollable sources of bacteria (e.g. bird and wildlife feces) in the wet weather loads generated in the watersheds, which can, by themselves, cause exceedances of the WQOs. Loads from these sources are natural and largely uncontrollable and therefore do not warrant regulation. The reference system approach was not used for dry weather TMDL analysis because the dry weather TMDLs used the geometric mean WQOs as numeric targets. Exceedances of the geometric mean WQOs for REC-1 beneficial uses was not observed in reference systems under dry weather conditions.

The interim wet weather TMDLs were based on the TMDLs calculated using the reference system approach for REC-1 beneficial uses. The interim wet weather TMDLs need to be achieved in a shorter time period than the “final” wet weather TMDLs, which were calculated based on the numeric targets without the reference system approach. Final wet weather TMDLs were calculated for REC-1 beneficial use. The final wet weather TMDLs must meet WQOs in the receiving water without application of a reference system approach because, at this time, the Basin Plan does not authorize the implementation of single sample bacteria WQOs using this approach. A Basin Plan amendment authorizing implementation of single sample bacteria WQOs using a reference system approach is being developed by the San Diego Water Board under a separate effort from this TMDL project.

In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. For both wet weather and dry weather TMDL calculations, an implicit MOS was included through the application of conservative assumptions throughout TMDL development. An explicit MOS was also included for the dry weather TMDLs to account for additional uncertainty in the analyses.

The wet weather and dry weather load analyses were used to estimate actual bacteria loads to Tecolote Creek. These estimated wet and dry weather loads were compared to the wet and dry TMDLs based on the appropriate numeric targets based on WQOs. Basically, the difference between the actual load and the TMDL is the load reduction required to attain the TMDL.

Once calculated, the TMDL is set equal to the sum of individual waste load allocations (WLAs) for point sources, and LAs for nonpoint sources and natural background levels. Load reduction requirements are assigned to controllable point sources and nonpoint sources. The only point sources identified to affect Tecolote Creek were MS4s, although other point sources of bacteria may exist. The estimated loads were solely the result of watershed runoff, not other types of point sources. WLAs were assigned to municipalities (the City of San Diego) and Caltrans. No controllable nonpoint sources were identified in the Tecolote Creek watershed.

There is legal authority and a regulatory framework that empowers the San Diego Water Board to require dischargers to implement and monitor compliance with the requirements set forth in these TMDLs. As previously noted, bacteria are transported to the impaired Tecolote Creek through wet and dry weather runoff generated from human habitation and land use practices. Much of these bacteria discharges result from controllable water quality factors which are defined as those actions, conditions, or circumstances resulting from man's activities that may influence the quality of the waters of the State and that may be reasonably controlled. These TMDLs establish wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources for these controllable discharges.

The regulatory framework for point sources of pollution differs from the regulatory framework for nonpoint sources. CWA section 402 establishes the NPDES program to regulate the ‘‘discharge of a pollutant,’’ other than dredged or fill materials, from a ‘‘point source'' into ''waters of the U.S.'' Under section 402, discharges of pollutants to waters of the U.S. are authorized by obtaining and complying with NPDES permits. These permits commonly contain effluent limitations consisting of either Technology Based Effluent Limitations (TBELs) or Water Quality Based Effluent Limitations (WQBELs).

In California, State Waste Discharge Requirements (WDRs) for discharges of pollutants from point sources to navigable waters of the United States that implement federal NPDES requirements and CWA requirements (NPDES requirements) serve in lieu of federal NPDES permits. These are referred to as NPDES requirements. Such requirements are issued by the State pursuant to independent state authority described in California's Porter Cologne Water Quality Control Act.

Persons responsible for point source discharges of bacteria to Tecolote Creek include municipal phase I urban runoff dischargers, municipal phase II urban runoff dischargers, and Caltrans. All but the phase II urban runoff discharges are regulated under NPDES requirements. Phase II urban runoff discharges in the San Diego Region have yet to be enrolled under the applicable NPDES requirements.

For each TMDL where nonpoint sources are determined to be significant, a LA is determined which is the maximum amount of a pollutant that may be contributed to a waterbody by "nonpoint source" discharges in order to attain WQOs. The Porter-Cologne Water Quality Control Act applies to both point and nonpoint sources of pollution and serves as the principle legal authority in California for the application and enforcement of TMDL LAs for nonpoint sources. The State plan and policy for control and regulation of nonpoint source pollution is contained in the *Plan for California's Nonpoint Source Pollution Control Program* (NPS Program Plan), and the *Policy for the Implementation and Enforcement of the Nonpoint Source Pollution Control Program* (NPS Implementation and Enforcement Policy).

Controllable nonpoint sources that warrant regulation include, for example, runoff from the Mesa College animal facility.[1] Mesa College animal facility is subject to the terms and conditions of the Basin Plan Waste Discharge Requirement Waiver Policy (Waiver Policy).[2] This policy applies to discharges from agricultural irrigation return flow, nursery irrigation return flow, orchard irrigation return flow, animal feeding operations, manure composting, soil amendment operations, and septic systems. Individual landowners and other persons engaged in these land use activities can be held accountable for attaining bacteria load reductions in affected watersheds through enforcement of WDRs and the Waiver Policy.

[1] The Mesa College animal facility may also be regulated under a Phase II storm water requirements since it is apart of Mesa College.
[2] The San Diego Water Board may waive issuance of WDRs for a specific discharge or types of discharge pursuant to CWC section13269 if such waiver is determined not to be against the public interest. The waiver of WDRs is conditional and may be terminated at any time by the San Diego Water Board for any specific discharge or any specific type of discharge.

Nonpoint source discharges from natural sources (bacteria deposition from aquatic and terrestrial wildlife, and bacteria bound in soil, humic material, etc.) are considered largely uncontrollable, and therefore should not be regulated. Bacteria discharged in runoff from open space and open recreation lands are examples of land uses that generate uncontrollable nonpoint bacteria sources.

In order to meet the TMDL, an Implementation Plan was developed and describes the regulatory and/or enforcement actions that the San Diego Water Board may take to compel dischargers to reduce pollutant loading and monitor effluent and/or receiving water. The Implementation Plan describes the pollutant reduction actions that can and must be taken by various dischargers to meet the allocations. A time schedule for meeting the required pollutant reductions is included in the Implementation Plan. The Implementation Plan includes provisions to perform studies by the dischargers to fill data gaps, refine the TMDLs and required load reductions, and/or modify compliance requirements. The dischargers will be ordered to conduct monitoring to assess the effectiveness of the implementation measures at meeting the wasteload reductions.

1 Introduction

The purpose of this technical report is to present the development of the Total Maximum Daily Loads (TMDLs) for indicator bacteria in Tecolote Creek, which is a tributary to Mission Bay. Fecal bacteria originate from the intestinal flora of warm-blooded animals, and their presence in surface waters is used as an indicator of human pathogens. Pathogens can cause illness in recreational water users. TMDLs for indicator bacteria were developed to address bacteria-impaired Tecolote Creek, as identified on the *2006 Clean Water Act Section 303(d) List of Water Quality Limited Segments* (2006 list).

Section 303(d) of the Clean Water Act (CWA) requires that each state identify waterbodies within its boundaries for which the effluent limitations are not stringent enough to meet applicable water quality standards, which consist of beneficial uses, water quality objectives (WQOs), and an antidegradation policy. The CWA also requires states to establish a priority ranking for these impaired waters, known as the *Clean Water Act Section 303(d) List of Water Quality Limited Segments*, and to establish TMDLs for the identified waterbodies.

Disease-causing pathogens include bacteria, viruses, and protozoa. Most disease-causing pathogens exist in very small amounts and are very difficult and expensive to detect in water samples. However, the presence of disease-causing pathogens in water can often be correlated to “indicator organisms.” Therefore, indicator organisms are used to help detect the presence of these disease-causing pathogens in water.

Indicator organisms have been used for more than a century to help identify where disease-causing pathogens may be present. These indicator organisms generally do not cause illness themselves, but they have characteristics that make them good indicators of harmful pathogens that may be present in the water. Fecal bacteria are often used as indictors for the presence of pathogens. When fecal bacteria are present in surface water in high quantities, this indicates a higher likelihood that pathogens are present in the water. Total coliform (TC), fecal coliform (FC), *Enterococcus* (ENT), and *Escherichia coli* (*E. coli),* which are fecal bacteria indicators, are often used as indicator organisms, when evaluating the quality of water. These organisms are collectively referred to as “indicator bacteria.” For a discussion of the use of indicator bacteria to measure water quality and the presence of pathogens, see Appendix A.

The purpose of a TMDL is to attain WQOs that support beneficial uses in the waterbody. A TMDL is defined as the sum of the individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background such that the capacity of the waterbody to assimilate pollutant loading (i.e., the loading capacity) is not exceeded.[3] Therefore, a TMDL represents the maximum amount of the pollutant of concern that the waterbody can receive and still attain water quality standards. Additionally, a TMDL represents a strategy for meeting WQOs by allocating quantitative limits for point and nonpoint pollution sources. Once this total

[3] 40 CFR 130.2

maximum pollutant load has been calculated, it is divided up and allocated among all of the contributing sources in the watershed.

The TMDL process begins with the development of a technical analysis which includes the following 7 components:

(1) **Problem Statement** – describes which WQOs are not being attained and which beneficial uses are threatened or impaired (section 2);
(2) **Numeric Targets** – identifies numeric targets which will result in attainment of the WQOs and protection of beneficial uses (section 3);
(3) **Source Analysis** – identifies all of the point sources and nonpoint sources of the impairing pollutant in the watersheds (section 5);
(4) **Linkage Analysis** – calculates the **Loading Capacity** (i.e., the maximum load of the pollutant that may be discharged to the waterbody without causing exceedances of WQOs and impairment of beneficial uses) of the waterbodies for the pollutant (sections 6 and 7);
(5) **Margin of Safety** (MOS) – accounts for uncertainties in the analyses (section 7);
(6) **Seasonal Variation and Critical Conditions** – describes how these factors are accounted for in the TMDL determination (section 7); and
(7) **Allocation of the TMDL** – division of the TMDL among each of the contributing sources in the watershed; wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint and background sources (section 8).

The write-up of the above components is generally referred to as the technical TMDL analysis.

This technical report also includes an **Implementation Plan** (sections 9 and 10). In order to meet the TMDLs, an Implementation Plan was developed which describes the regulatory and/or enforcement actions that the San Diego Water Board may take to compel dischargers to reduce pollutant loading and monitor effluent and/or receiving water. The Implementation Plan also identifies pollutant reduction actions or strategies available to the various dischargers to meet the allocations. The Implementation Plan describes the pollutant reduction actions that must be taken by various dischargers to meet the allocations. A compliance schedule for meeting the required pollutant reductions is included in the Implementation Plan. The Implementation Plan includes provisions to perform studies by the dischargers to fill data gaps, refine the TMDLs and required load reductions, and/or modify compliance requirements. The dischargers will be ordered to conduct monitoring to assess the effectiveness of the implementation measures at meeting the load and wasteload reductions.

1.1 Technical Approach

Because the climate in southern California has two distinct hydrological patterns, two methods were developed for estimating bacteria loads. One method, based on a computer model of the watershed, specifically quantified loading during wet weather (storm) events, which tend to be episodic and short in duration, and are characterized by rapid wash-off and transport of very high bacteria loads from all land use types. The wet weather approach is consistent with the methodologies used for bacteria TMDL development for impaired coastal areas of the Los Angeles Region, specifically Santa Monica Bay beaches (Los Angeles Water Board, 2002), Malibu Creek (Los Angeles Water Board, 2003), and beaches and creeks in the San Diego Region (San Diego Water Board, 2007).

In contrast, the bacteria loading during dry weather conditions was estimated using observed flow and bacteria density data along Tecolote Creek. This estimated load is representative of the average flow and bacteria loading conditions resulting from various urban land use practices (e.g., runoff from lawn irrigation or sidewalk washing). Dry weather loading was much smaller in magnitude, did not occur from all land use types, and exhibited less variability over time.

In addition to estimating existing loading, the wet weather watershed model and dry weather observed flow data were used to estimate TMDLs for the two climate conditions for the watershed.

TMDLs were calculated and reported for interim and final wet weather implementation phases. For wet weather TMDL calculations, final TMDL calculations were based on the numeric WQOs in the Basin Plan, whereas interim wet weather TMDLs were derived using the numeric WQOs in the Basin Plan and applying a “reference system approach,” which takes into account loading of bacteria from natural sources. The reference system approach allows a 22 percent exceedance frequency of the single sample WQOs for water contact recreation (REC-1) beneficial uses. Twenty-two percent is the frequency of exceedance of the single sample maximum WQO measured in a reference system in Los Angeles County. A reference system is a beach and upstream watershed that are minimally impacted by anthropogenic activities. A reference system typically has at least 95 percent open space. The purpose of the exceedance frequency is to account for the natural and largely uncontrollable sources of bacteria (e.g. bird and wildlife feces) in the wet weather loads generated in the watersheds, which can, by themselves, cause exceedances of the WQOs. Loads from these sources are natural and largely uncontrollable and therefore do not warrant regulation.

The San Diego Water Board is developing a reference system/natural sources exclusion approach Basin Plan amendment under a separate effort from this TMDL project.[4] This amendment would authorize exceedances of single sample enterococci and fecal coliform WQOs (REC-1) using the frequency of a reference system in the context of a TMDL. The Basin Plan amendment is independent from any TMDL and will have its own public participation process. If this Basin Plan amendment is adopted by the San Diego Water Board, and approved by the State Water Resources Control Board (State Water Board), Office of Administrative Law (OAL), and U.S. Environmental Protection Agency (USEPA), the final wet weather TMDLs for enterococci and fecal coliform in this TMDL project can be revised. Final TMDLs can be recalculated and established in a separate Basin Planning process.

[4] This Basin Plan issue ranked seventh on the 2004 Triennial Review list of priority projects.

The reference system approach was not used for dry weather TMDL analysis because exceedance frequencies of geometric mean WQOs in reference creeks have not yet been characterized. However, if adequate data are collected to characterize dry weather flows and bacteria densities, the dry weather TMDLs could be recalculated based on this reference system approach.

The Basin Plan amendment will also authorize the implementation of single sample and geometric mean enterococci and fecal coliform WQOs (REC-1 & REC-2) using a natural sources exclusion approach in the context of a TMDL. This approach will authorize the development of a TMDL that results in exceedances of WQOs after all sources of indicator bacteria associated with human and domesticated animal wastes are controlled. Under the natural sources exclusion approach, after all such anthropogenic sources of indicator bacteria have been controlled, a certain frequency of exceedance of the WQOs can be authorized for developing TMDLs based on the residual exceedance frequency of the WQO in the water body. The residual exceedance frequency can be used to calculate the allowable exceedance load due to natural sources. Alternatively, a TMDL could also be calculated directly, without an allowable exceedance frequency, based on the existing bacteria loading in the waterbody after anthropogenic sources have been adequately controlled. This approach could be used to revise TMDLs based on single sample and geometric mean WQOs.

In this TMDL project, WLAs were calculated for point source discharges and LAs were calculated for nonpoint source discharges. Two WLAs were calculated for the Tecolote Creek watershed; one for Caltrans and one for municipal separate storm sewer system (MS4) discharges. LAs were calculated for non-controllable nonpoint sources from open space land uses. The only controllable nonpoint source identified in the Tecolote Creek watershed is the Mesa College animal facility.[5]

[5] The Mesa College animal facility may also be regulated under a Phase II storm water requirements since it is apart of Mesa College.

2 Problem Statement

The presence of high quantities of bacteria in surface waters can indicate a higher potential risk to human health. Sources of bacteria under all conditions vary widely and include natural sources such as feces from aquatic and terrestrial wildlife, and anthropogenic sources such as sewer line breaks, trash, and pet waste. Once in the environment, bacteria can also re-grow and multiply.

Of particular concern are disease-causing pathogens. Disease-causing pathogens are a risk to human health in surface waters. When the risk to human health from pathogens in the water is great, the quality and beneficial uses of the water are impaired.

At present, analyzing water for specific disease-causing pathogens directly is very difficult and expensive. However, the presence of disease-causing pathogens in water can often be correlated to indicator bacteria, such as TC, FC, E.coli, and ENT. When these indicator bacteria are present in surface waters in high quantities, this indicates a higher likelihood that pathogens are present in the water.

Bacteria quantities, written in terms of densities of bacteria colonies (most probable number per 100 milliliters of water [MPN/100 mL]), in the waters of Tecolote Creek reportedly have exceeded the numeric WQOs for TC, FC, E.coli and/or ENT indicator bacteria. These exceedances threaten and/or impair the water contact (REC-1) and non-water contact (REC-2) beneficial uses of Tecolote Creek and Mission Bay (which is downstream of Tecolote Creek). Although Mission Bay is not directly addressed in this current TMDL project, the impact of Tecolote Creek to the bay is considered in these TMDLs. A discussion of REC-1 WQOs for indicator bacteria is provided in Appendix B.

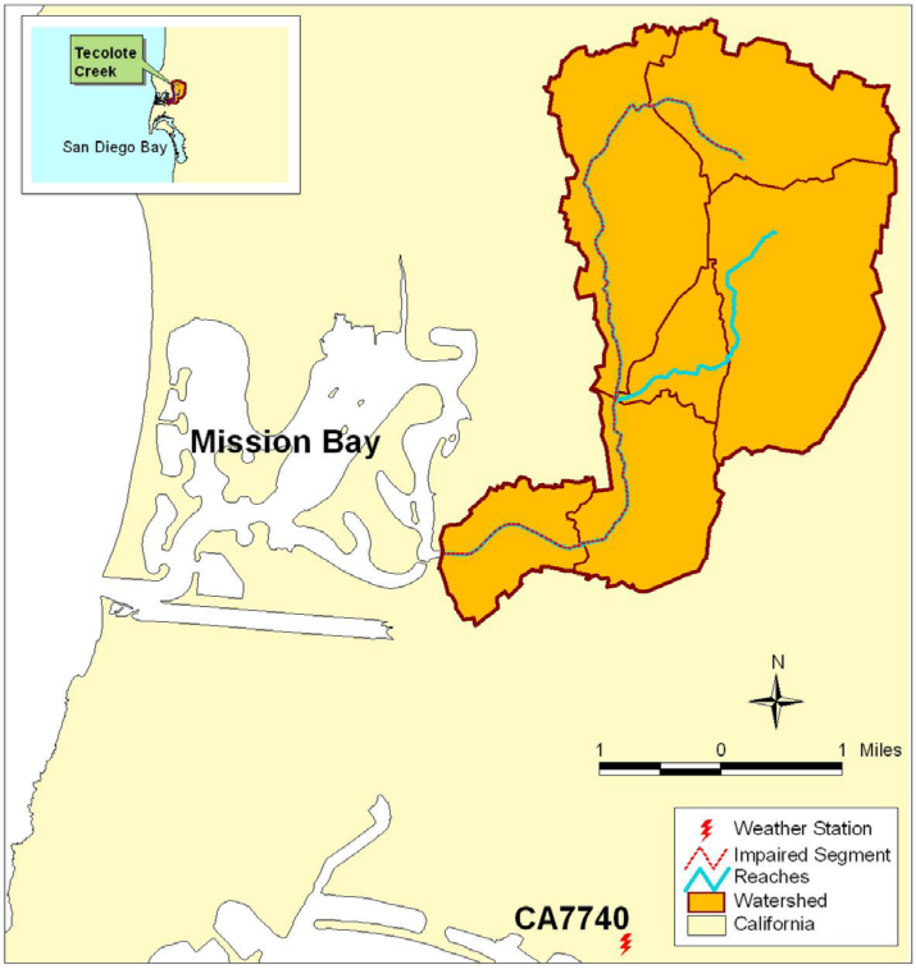
Tecolote Creek is designated with REC-1 and REC-2 beneficial uses. REC-1 includes uses of water for recreational activities involving body contact with water (such as swimming or other water sports), where ingestion of water is reasonably possible. REC-2 includes the uses of water for recreational activities involving proximity to water, but not normally involving body contact with water (such as picnicking and sunbathing), where ingestion of water is reasonably possible. For this TMDL analysis, the REC-1 beneficial use was evaluated, because if the REC-1 beneficial use is protected, the REC-2 beneficial use will also be protected due to more stringent WQOs associated with the REC-1 use. The following sub-sections provide additional information about the environmental settings, the beneficial uses and WQOs, and overview of the reported impairments of the waterbodies evaluated in this technical report.

2.1 Project Area Description

Tecolote Creek is in southern San Diego County, California. The Creek flows directly to Mission Bay (Figure 2-1). The watershed covers roughly 10 square miles (26 square kilometers). Percentages of land uses in the Tecolote Creek watershed are displayed in Table 2-1.

Table 2-1. Land Uses in the Tecolote Creek Watershed

low-density residential	48.2 percent	high-density residential	7.8 percent
commercial/institutional	18.8 percent	parks/recreation	3.1 percent
open space	17.4 percent	open recreation	0.9 percent
industrial/transportation	3.6 percent	Military	0.3 percent



Deleted:

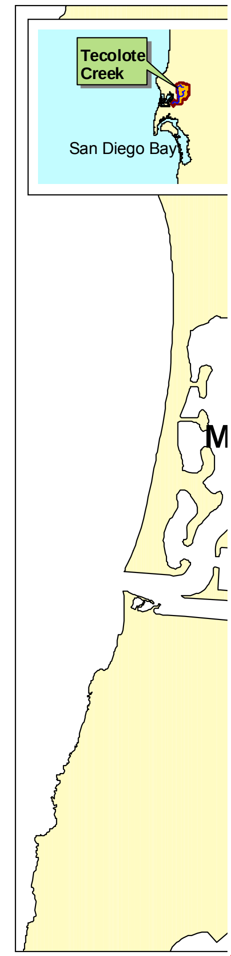


Figure 2-1. Tecolote Creek Watershed.

The climate in the Region is generally mild with annual temperatures averaging around 65°F near the coastal areas. Average annual rainfall ranges from 9 to 11 inches along the coast. There are three distinct types of weather in the Region. Summer dry weather occurs from late April to mid-October. During this period almost no rain falls.

The winter season (mid-October through early April) has two types of weather; 1) winter dry weather when rain has not fallen for the preceding 72 hours, and 2) wet weather consisting of storms of 0.2 inches of rainfall and the 72 hour period after the storm. Eighty five to 90 percent of the annual rainfall occurs during the winter season (County of San Diego, 2000).

2.2 Applicable Water Quality Standards

Water quality standards consist of WQOs, beneficial uses, and an anti-degradation policy. WQOs are defined under Water Code section 13050(h) as "limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water." Under section 304(a)(1) of the CWA, the USEPA is required to publish water quality criteria that incorporate ecological and human health assessments based on current scientific information. WQOs must be based on scientifically sound water quality criteria, and be at least as stringent as those criteria.

All possible beneficial use designations are as follows:

- Municipal and domestic supply (MUN)
- Agricultural supply (AGR)
- Industrial process supply (PROC)
- Industrial water supply (IND)
- Ground water recharge (GWR)
- Freshwater replenishment (FRSH)
- Navigation (NAV)
- Hydropower generation (POW)
- Water contact recreation (REC-1)
- Non-contact recreation (REC-2)
- Commercial and sport fishing (COMM)
- Aquaculture (AQUA)
- Warm freshwater habitat (WARM)
- Cold freshwater habitat (COLD)
- Inland saline water habitat (SAL)
- Estuarine habitat (EST)
- Marine habitat (MAR)
- Wildlife habitat (WILD)
- Preservation and enhancement of "Areas of Special Biological Significance" (BIOL)
- Rare and endangered species (RARE)
- Migration of aquatic organisms (MIGR)
- Spawning, reproduction, and/or early development (SPWN)
- Shellfish harvesting (SHELL)

The Basin Plan identifies the beneficial uses and WQOs for Tecolote Creek and Mission Bay, which are presented in Table 2-2. This table includes both Tecolote Creek and Mission Bay because, as previously described above, the loadings from Tecolote Creek impact the downstream water quality of Mission Bay.

Table 2-2. Beneficial Uses of the Impaired Waters

Waterbody Type	Waterbody	Designated Beneficial Uses
Creek	Tecolote Creek	REC-1,[a] REC-2, WARM, WILD
Bay	Mission Bay	IND, REC-1, REC-2, COMM, EST, WILD, RARE, MAR, MIGR, SPWN, SHELL

Source: San Diego Water Board, 1994.
[a] This use is listed as a potential beneficial use.

REC-1 and REC-2 beneficial uses for inland surface waters have WQOs for bacteria, which are defined in the Basin Plan. The WQOs are derived from water quality criteria promulgated by the USEPA in 1976, 1986, and 2004. The Basin Plan contains REC-1 WQOs for TC, FC, *E. Coli*, and ENT and REC-2 WQOs for FC[6]. Compliance with numeric WQOs must be assessed and maintained throughout a waterbody to protect beneficial uses. For a complete discussion of WQOs for each beneficial use and each type of waterbody, see Appendix B.

2.3 Impairment Overview

Tecolote Creek and Mission Bay are listed as impaired because of non-attainment of the indicator bacteria WQOs associated with their REC-1 and REC-2 beneficial uses. Section 4.2 discusses data analyses for wet and dry weather data in the Tecolote Creek watershed. These analyses confirm that both the wet and dry weather data exceed WQOs associated with the REC-1 beneficial use for three indicator bacteria.

To address these impairments, a watershed-based approach was developed to calculate bacteria loadings for the 6.6 miles of impaired creek, which is shown in Figure 2-1, and drains approximately 10 square miles into Mission Bay. This approach includes separate methodologies to address the unique characteristics associated with wet and dry weather, which are discussed in sections 6.2 and 6.3, respectively.

[6] Where REC-1 use is not designated.

3 Numeric Target Selection

When calculating TMDLs, numeric targets are selected to meet WQOs for a waterbody and subsequently ensure the restoration and/or protection of beneficial uses. The TMDL has a multi-part numeric target based on the bacteriological WQOs for inland surface waters to protect the water contact (REC-1) use. Their targets are the most appropriate indicators of public health risk in recreational waters. The bacteriological WQOs are set forth in the Basin Plan and are based on four indicator bacteria, TC, FC, ENT, and *E. Coli*. They include both geometric mean limits and single sample limits. The Basin Plan's objectives that serve as numeric targets for these TMDLs are:

REC-1
Inland Surface Waters, Enclosed Bays and Estuaries and Coastal Lagoons (from Basin Plan)

Fecal Coliform / Fresh or Marine Waters: Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 per 100 ml, nor shall more than 10 percent of total samples during any 30-day period exceed 400 per 100 ml.

Total Coliform / Bays and Estuaries only: Coliform organisms shall be less than 1,000 MPN per 100 ml (10 per ml); provided that not more than 20 percent of the samples at any station, in any 30-day period, may exceed 1,000 MPN per 100 ml (10 per ml) and provided further that no single sample when verified by a repeat sample taken within 48 hours shall exceed 10,000 MPN per 100 (100 per ml).

Enterococci / Fresh Waters: In fresh water, the geometric mean of enterococci shall not exceed 33 colonies per 100 ml. The single sample maximum allowable density in designated beach areas is 61 colonies per 100 ml, in moderately or lightly used areas is 108 colonies per 100 ml, in infrequently used areas is 151 colonies per 100 ml.

***E. coli* / Fresh Waters:** In fresh water, the geometric mean of *E. coli* shall not exceed 126 colonies per 100 ml. The single sample maximum allowable density in designated beach areas is 235 colonies per 100 ml, in moderately or lightly used areas is 406 colonies per 100 ml, in infrequently used areas is 567 colonies per 100 ml.

These objectives are generally based on an acceptable health risk for recreational waters of 19 illnesses per 1,000 exposed individuals as set forth by the USEPA (US EPA, 1986). The targets apply throughout the year.

The numeric targets used in the TMDL calculations were selected from the REC-1 WQOs for TC, FC, and ENT. TMDLs were not calculated for *E. coli* because fecal coliform TMDLs and load reductions essentially account for E.coli. Selection of these numeric targets will ensure that the TMDLs result in water quality in Tecolote Creek that supports REC-1 beneficial uses, which will also protect REC-2 uses in the creek and downstream in Mission Bay. Even though bays and creeks are separate waterbodies with slightly different WQOs, Tecolote Creek eventually discharges to Mission Bay, and therefore WQOs applicable to Bays and Estuaries must be protected at creek mouths. In other words, although the total coliform objective is not an applicable WQO in freshwater creeks and rivers, the total coliform density at the mouth of Tecolote Creek where it discharges to Mission Bay must meet the Bays and Estuaries total coliform WQO. Although REC-1 WQOs for fecal coliform and enterococci apply throughout the watershed, the total coliform TMDLs must be met only at the mouth of Tecolote Creek where it discharges into Mission Bay.

The selected numeric targets were different for dry weather and wet weather because the bacteria transport mechanisms to receiving waters are different under each weather condition. Single sample maximum WQOs were used as wet weather numeric targets because wet weather flow, or storm flow, is episodic and short in duration, and characterized by rapid wash-off and transport of high bacteria loads, with short residence times, from all land use types to receiving waters. Geometric mean WQOs were used as numeric targets for dry weather periods because dry weather runoff is not generated from storm flows, is not uniformly linked to every land use, and is more uniform than stormflow, with lower flows, lower loads, and slower transport, making bacteria die-off and/or amplification processes more important.

Numeric targets for wet and dry weather are summarized in sections 3.1 and 3.2, respectively.

3.1 Wet Weather Targets

As discussed above, the REC-1 beneficial use in Mission Bay and Tecolote Creek was considered in the development of the bacteria TMDLs for Tecolote Creek. The REC-1 WQOs for FC and ENT are applicable to the entire length and mouth of Tecolote Creek. The REC-1 TC WQO for bays and estuaries is applicable in Mission Bay at the mouth of Tecolote Creek.

For reasons given above, the single sample maximum WQOs were selected as numeric targets for wet weather conditions. In addition, for the interim implementation period an allowable exceedance frequency is used in conjunction with the single sample maximum WQOs for REC-1. The purpose of the exceedance frequency is to account for the natural and largely uncontrollable sources of bacteria (e.g., bird and wildlife feces) in the wet weather loads generated in the watershed, which can, by themselves, cause exceedances of WQOs. The exceedance frequency is determined by using a reference system approach.

A reference system is a beach and upstream watershed that are minimally impacted by anthropogenic activities. The reference system approach also incorporates antidegradation principles in that, if water quality is better than that of the reference system in a particular location, no degradation of existing bacteriological water quality is permitted. The reference system approach was developed by the Los Angeles Regional Water Quality Control Board (Los Angeles Water Board), and is included in its

Basin Plan as an implementation policy for single sample maximum bacteria WQOs.[7] The reference system approach and its applicability to the San Diego Region is also described in the *Total Maximum Daily Loads for Indicator Bacteria Project I - Beaches and Creeks in the San Diego Region* (Bacteria Project I TMDL) (San Diego Water Board, 2007). Twenty-two percent is the frequency of exceedance of the REC-1 single sample maximum WQO measured in a reference system in Los Angeles County. This exceedance frequency was applied in calculating the interim wet weather TMDLs for Tecolote Creek.

The Basin Plan amendment will also authorize the implementation of single sample and geometric mean enterococci and fecal coliform WQOs (REC-1 & REC-2) using a natural sources exclusion approach in the context of a TMDL. This approach will authorize the development of a TMDL that results in exceedances of WQOs after all sources of indicator bacteria associated with human and domesticated animal wastes are controlled. Under the natural sources exclusion approach, after all such anthropogenic sources of indicator bacteria have been controlled, a certain frequency of exceedance of the WQOs can be authorized for developing TMDLs based on the residual exceedance frequency of the WQO in the water body. The residual exceedance frequency can be used to calculate the allowable exceedance load due to natural sources. Alternatively, a TMDL could also be calculated directly, without an allowable exceedance frequency, based on the existing bacteria loading in the waterbody after anthropogenic sources have been adequately controlled. This approach could be used to revise TMDLs based on single sample and geometric mean WQOs.

The reference system approach was used to calculate wet weather TMDLs for the interim implementation phase, only. The final wet weather TMDLs must meet WQOs in the receiving water without application of a reference system approach because, at this time, the Basin Plan does not authorize the implementation of single sample maximum bacteria WQOs using the reference system approach. However, after the Basin Plan Amendment authorizing usage of the reference system approach is adopted, the wet weather TMDLs can be recalculated based on the 22% exceedance frequency or the exceedance frequency in an appropriate reference creek.

A Basin Plan amendment authorizing implementation of single sample maximum bacteria WQOs using a reference system approach is being developed by the San Diego Water Board under a separate effort from this TMDL project. The Basin Plan amendment authorizing a reference system approach is independent from any TMDL and will have its own public participation process. If this Basin Plan amendment is adopted by the San Diego Water Board, and approved by the State Water Board, OAL, and USEPA, the final wet weather targets in this TMDL project can be revised. Final

[7] The Los Angeles Water Board used the Arroyo Sequit Watershed as the reference system watershed for development of TMDLs for the Santa Monica Bay beaches and Malibu Creek (Los Angeles Water Board, 2002 and 2003). This watershed, consisting primarily of unimpacted land use (98 percent open space), discharges to Leo Carillo Beach, where 22 percent of wet weather fecal coliform data (10 out of 46 samples) were observed to exceed the single sample maximum WQOs).

TMDLs can be recalculated and established in a separate Basin Planning process in accordance with San Diego Water Board priorities and resources.

For Tecolote Creek (Table 3-1), the interim and final wet weather numeric targets are the same; however, the interim single sample maximum values can be exceeded 22 percent of the time during the interim implementation phase. The final numeric targets cannot be exceeded during the final implementation phase. The interim and final wet weather numeric targets are 10,000 MPN/1000 mL for TC; 400 MPN/100 mL for FC; and 61 MPN/100 mL for ENT depending on the frequency of usage.[8] The FC and ENT targets are applicable along the entire length of Tecolote Creek, while the TC targets are for Mission Bay, at the mouth of Tecolote Creek.
As a conservative approach, the freshwater designated beach WQO was used as the numeric target for the enterococci TMDLs for Tecolote Creek and its downstream beach at Mission Bay. However, the dischargers commented that the “designated beach” category may be over-protective of water quality because of the infrequent recreational use in Tecolote Creek. The recreational usage frequency in this creek may correspond to the “moderately or lightly used area” category in the Basin Plan, which has an enterococci WQO of 108 MPN/100mL. In these cases, using a less stringent numeric target, based on the saltwater enterococci WQO of 104 MPN/100 mL (“designated beaches” usage frequency) would result in TMDLs protective of REC-1 use in the creek and at the downstream beach. Therefore, if the “moderately to lightly used area” usage frequency is appropriate for Tecolote Creek, the WQO of 104 MPN/100 mL should be used as the numeric target. Since the information to make this evaluation is not available, the enterococci TMDLs were calculated using both numeric targets. However, the dischargers should submit evidence justifying the “moderately to lightly used area” usage frequency for the four impaired creeks before the San Diego Water Board issues orders to implement the TMDLs. Otherwise, we will implement the more stringent enterococci TMDLs based on the “designated beach” usage frequency.

Comment [s2]: Plots are attached as a separate document; not sure how you want them included/addressed so I did not add the figures to the report or add any text.Did

Table 3-1. Interim and Final Wet Weather Numeric Targets for Tecolote Creek

Indicator Bacteria	Interim Targets		Final Targets	
	Numeric Target[a] (MPN/100mL)	Allowable Exceedance Frequency[b]	Numeric Target[a] (MPN/100mL)	Allowable Exceedance Frequency[c]
Total coliform	10,000	22%	10,000	Not applicable
Fecal coliform	400	22%	400	Not applicable
Enterococcus	61	22%	61	Not applicable

[a] Targets based on REC-1 single sample maximum WQOs.
[b] Exceedance frequency based on reference system in the Los Angeles Region.
[c] Not applicable because there is no authorization for a reference system approach in the Basin Plan.

[8] The enterococci WQOs in the Basin Plan are structured to reflect the frequency of recreational use. The enterococci freshwater WQO for a “designated beach” area is 61 MPN/100 mL. For a “moderately or lightly used area,” the WQO is 108 MPN/100 mL. Where the “moderately or lightly used area” designation is appropriate for creeks, the saltwater WQO of 104 MPN/100 mL could be used as the numeric target because it is also protective of both the freshwater creek and the downstream marine beach.

3.2 Dry Weather Targets

As with the numeric targets selected for wet weather, numeric targets for dry weather were selected for the REC-1 beneficial use. The REC-1 WQOs for FC and ENT are applicable to the entire length and mouth of Tecolote Creek. The REC-1 WQO for TC for bays and estuaries is applicable in Mission Bay at the mouth of Tecolote Creek.

For reasons given above, the 30-day geometric mean WQOs were selected as numeric targets for dry weather conditions. Dry weather numeric targets consist of the 30-day geometric mean or median WQOs. These targets are appropriate for the dry weather analysis because the dry weather approach is based on average flows, unlike the wet weather analysis, which is based on maximum flows. Since the 30-day geometric mean or median WQO represents an average bacteria density of 5 samples over 30 days, it is an appropriate numeric target to use with an average flow. However, unlike the wet weather numeric targets, there is no allowable exceedance frequency or reference system approach used.

For Tecolote Creek (Table 3-2), the dry weather numeric targets are 200 MPN/100 mL for FC; and 33 MPN/100 mL for ENT (30-day geometric mean). For Mission Bay at the mouth of Tecolote Creek, the dry weather numeric target is 1,000 MPN/100 mL for TC. Dry weather numeric targets use the REC-1 WQOs for FC and ENT along the length and TC at the mouth of Tecolote Creek.

Table 3-2. Numeric Dry Weather Targets for Tecolote Creek

Indicator Bacteria	Targets[a] (MPN/100 mL)
Total coliform	1,000
Fecal coliform	200
Enterococcus	33

[a] Targets based on REC-1 30-day geometric mean WQOs.

4 Data Inventory and Analysis

Data from several sources were used to characterize the watershed and water quality conditions, identify land uses associated with bacteria sources, and support the calculation of TMDLs for the watersheds. No new data were collected as part of this effort. The data analysis provided an understanding of the conditions that result in impairments.

4.1 Data Inventory

The categories of data used in developing these TMDLs include physiographic data that describe the physical conditions of the watershed and environmental monitoring data that identify past and current conditions and support the identification of potential pollutant sources. Table 4-1 presents the various data types and data sources used in the development of these TMDLs. The following sections describe the key data sets used for TMDL development.

Table 4-1. Inventory of Data Used for the Source Assessment of Bacteria

Type of Information	Data Source(s)	Purpose
Geographical Information System (GIS) Data		
Stream network	US Geologic Survey (USGS) National Hydrography Dataset (NHD) reach file	Determination of representative modeled stream for each sub-watershed
Land use	San Diego Association of Governments (SANDAG) Regional Planning Agency – 2000 land use coverage for San Diego County	Designation of land uses in the region
Soils	US Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) State Soil Geographic (STATSGO) database	STATSGO soil data used for modeling
Topographic data	US Environmental Protection Agency (USEPA) Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) digital elevation models (DEMs)	To determine watershed characteristics, such as slope
Watershed boundaries	California Watershed Map 1995 (CalWater Version 2.2)	Existing watershed boundary layers used for subwatershed delineation
	Watershed boundaries from the City of San Diego Mission Bay Water Quality Survey (Supplemental Environmental Project)	
Monitoring Data		
Water quality monitoring data	City of San Diego Mission Bay Water Quality Survey (Supplemental Environmental Project) – Stations MBW06-MBW10	Instantaneous bacteria measurements used for dry and wet weather data analyses and dry weather existing load calculations
	National Pollutant Discharge Elimination System (NPDES) Receiving Waters Monitoring Program – Tecolote Creek Wet Weather Mass Loading Station	Continuous and instantaneous bacteria measurements used for model validation

Type of Information	Data Source(s)	Purpose
	NPDES Dry Weather Monitoring Program– Stations DW108, DW109, DW114, DW275, DW279, DW280	Instantaneous bacteria measurements used for dry weather data analyses and existing load calculations
Streamflow data	City of San Diego Mission Bay Water Quality Survey (Supplemental Environmental Project) – Stations MBW06-MBW10	Instantaneous flow measurements used for dry weather data analyses and TMDL calculations
	NPDES Receiving Waters Monitoring Program – Tecolote Creek Wet Weather Mass Loading Station	Continuous flow measurements used for model validation
Meteorological data	National Oceanic and Atmospheric Administration - National Climatic Data Center (NOAA-NCDC) COOP ID No. 047740	Hourly rainfall data used for hydrologic and water quality modeling for wet-weather conditions
	California Irrigation Management Information System (CIMIS)	Evaporation data used for hydrologic and water quality modeling for wet-weather conditions

4.1.1 Water Quality Data

Monitoring data for the impaired creek were received from the County of San Diego and the City of San Diego. Data were received for many stations and were associated with several independent, yet complimentary, monitoring programs (Figure 4-1). These monitoring programs include the City of San Diego Mission Bay Water Quality Survey (Supplemental Environmental Project) and the National Pollutant Discharge Elimination System (NPDES) Receiving Waters Monitoring and Dry Weather Monitoring Programs.

The Mission Bay Water Quality Survey collected TC, FC, and ENT data from 2001 to 2004 at five locations in the Tecolote Creek watershed. The NPDES Receiving Waters Monitoring Program collected samples for several storms annually at the Tecolote Creek Mass Loading Station from 1993 to 2005 (County of San Diego, 2005). These samples were analyzed for several parameters, including TC, FC, and ENT. The City of San Diego also analyzed dry weather samples at several stations in the Tecolote Creek watershed as part of their NPDES Dry Weather Monitoring Program. Some of the samples were collected in open channels, while others were collected at outlets or pipes in order to characterize the loadings to Tecolote Creek. Only the samples from within Tecolote Creek were included in our data analyses (section 4.2).

4.1.2 Stream Flow Data

The assessment of waterbody characteristics involved analyzing streamflow data and assessing physical information. This information was used to determine the volume and hydraulic features of waterbodies for determining assimilative capacity and physical processes that affect bacteria transport for TMDL analysis.

A limited amount of streamflow data for Tecolote Creek were available. Twelve monitored storm events at the Tecolote Creek Mass Loading Station (Figure 4-1) between November 2001 and February 2005 were used to verify and validate wet weather model performance for the Tecolote Creek watershed. These twelve storm events had high-frequency flow data and flow-weighted composite water quality data for comparison with wet weather model output (County of San Diego, 2005; Weston Solutions, Inc., 2005). Basic characteristics of the storm events are summarized in Appendix C. In addition, discrete flow measurements were available for some dry weather conditions. These data are summarized in section 4.2.

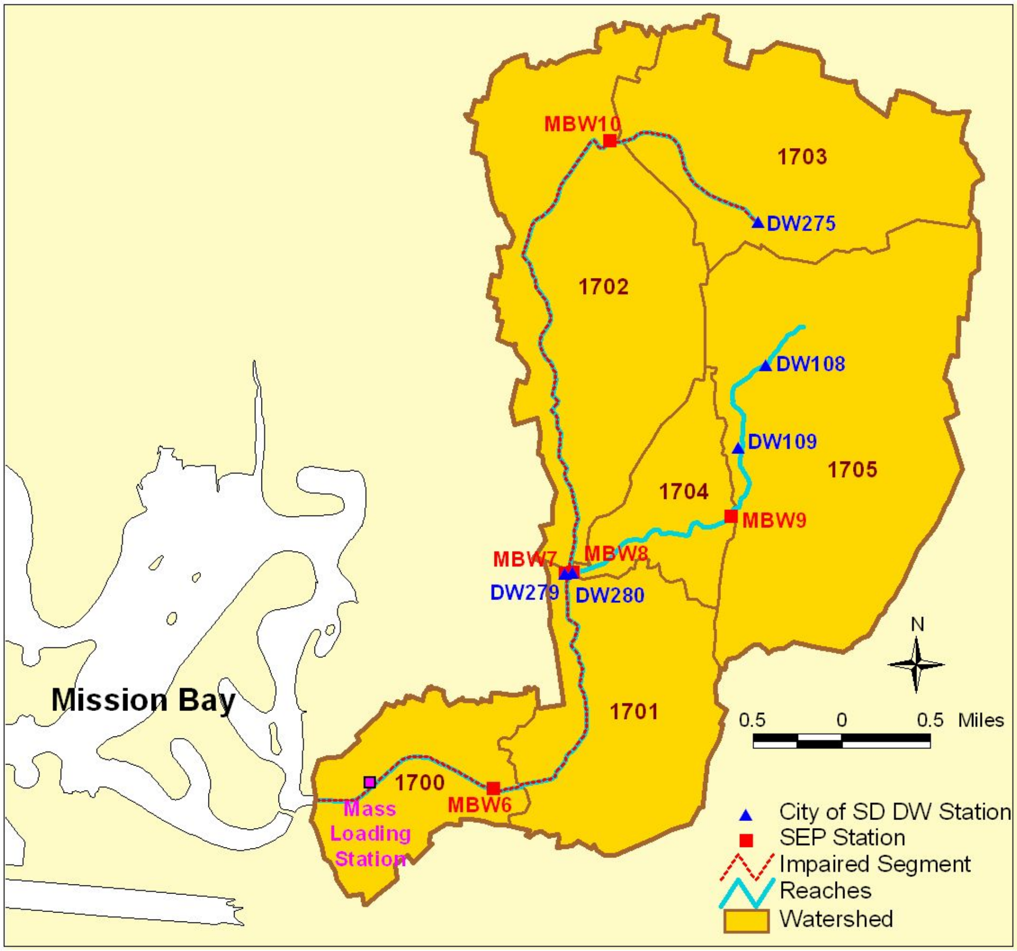
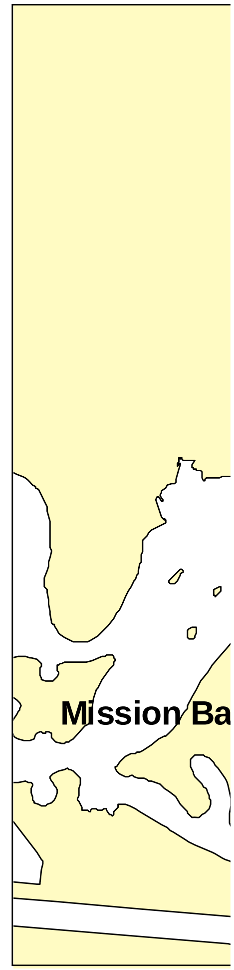


Figure 4-1. Bacteria monitoring stations on Tecolote Creek.

Deleted:



4.1.3 Meteorological Data

Hourly rainfall data were obtained from the National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA) at the San Diego

International Airport, Lindbergh Field (station CA7740). In addition, hourly evapotranspiration data were obtained from the California Irrigation Management Information System (CIMIS).

4.1.4 Land Characteristic Data

Available land use data to support this study included the San Diego Association of Governments (SANDAG) Regional Planning Agency 2000 data set for San Diego County. In addition, soil data were obtained from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) State Soil Geographic (STATSGO) database and topographic information was obtained from the USEPA's Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) system.

4.2 Review of Impaired Segments

Water quality bacteria data collected in the Tecolote Creek watershed were analyzed to provide guidance for the source assessment and verification of impairments through comparison with WQOs. Results of these analyses are reported in the following sections.

4.2.1 Wet Weather Data Analysis

Wet weather samples were analyzed for TC, FC, and ENT from six monitoring stations in the Tecolote Creek watershed (Figure 4-1). These stations include the Mass Loading Station near the mouth of Tecolote Creek and five stations from the City of San Diego Mission Bay Water Quality Survey (Supplemental Environmental Project), which were located throughout the watershed (Figure 4-1). The Mass Loading Station had data for several storms collected over thirteen years (1993 to 2005), while the data for the other stations were limited to one or two storms per year for three years (2001 to 2003).

The TC, FC, and ENT wet weather analytical results are presented in Tables 4-2 through 4-4, respectively. These tables include the number of samples, minimum, maximum, and geometric mean, among other summary statistics. These tables also present the exceedance frequency of REC-1 wet weather numeric targets (section 3.1), based on single sample maximums, for each station and indicator bacteria. These data indicate that the REC-1 WQOs are exceeded 75 to 100 percent of the time for all indicator bacteria at all stations. This is because high bacteria counts in the watershed generally lead to high bacteria counts downstream, which, in this case, is Mission Bay.

Table 4-2. Wet Weather Total Coliform (MPN/100mL) Data Summary

	Station					
	MBW06	**MBW07**	**MBW08**	**MBW09**	**MBW10**	**MLS**
Count	4	3	3	4	4	33
Minimum	31,300	43,520	122,300	117,800	137,400	240
Maximum	410,600	344,800	410,600	2,419,200	2,419,200	800,000
Mean	198,798	169,373	227,067	857,600	1,043,700	139,380
Geometric Mean	115,929	121,592	195,282	405,585	556,830	51,821
Standard Deviation	189,909	156,638	159,475	1,085,165	1,088,469	173,158
% Exceedance of REC-1 Target[a]	100%	100%	100%	100%	100%	84.8%

[a] REC-1 wet weather numeric target for total coliform (TC) is 10,000 MPN/100mL.

Table 4-3. Wet Weather Fecal Coliform (MPN/100mL) Data Summary

	Station					
	MBW06	**MBW07**	**MBW08**	**MBW09**	**MBW10**	**MLS**
Count	4	3	3	4	4	34
Minimum	331	712	1,669	1,989	2,014	<2
Maximum	5794	6,867	8,090	77,010	137,400	>160,000
Mean	3172	3,445	4,471	21,280	36,968	28,760
Geometric Mean	2,125	2,379	3,668	6,042	8,386	5,845
Standard Deviation	2,254	3,135	3,288	37,163	66,963	47,240
% Exceedance of REC-1 Target[a]	75%	100%	100%	100%	100%	91.2%

[a] REC-1 wet weather numeric target for fecal coliform (FC) is 400 MPN/100mL

Table 4-4. Wet Weather Enterococcus (MPN/100mL) Data Summary

	Station					
	MBW06	**MBW07**	**MBW08**	**MBW09**	**MBW10**	**MLS**
Count	4	3	3	4	4	15
Minimum	201	1,430	2,755	3,873	3,448	3,000
Maximum	10,540	9,600	6,131	32,550	11,190	300,000
Mean	5,267	6,397	4,686	13,188	6,431	39,933
Geometric Mean	2,422	4,821	4,437	9,546	5,689	17,388
Standard Deviation	4,977	4,361	1,740	13,086	3,663	74,889
% Exceedance of REC-1 Target[a]	100%	100%	100%	100%	100%	100%

[a] REC-1 wet weather numeric target for *Enterococcus* (ENT) is 61 MPN/100mL

4.2.2 Dry Weather Data Analysis

Dry weather flow, TC, FC, and ENT data were analyzed for several monitoring stations in the Tecolote Creek watershed. There were two sources of dry weather data included in the analyses. These included the City of San Diego Mission Bay Water Quality Survey (Supplemental Environmental Project), which provided in-stream monitoring results, and the City of San Diego NPDES Dry Weather Monitoring Program data, which consisted mostly of data from outlets (Figure 4-1). The dry weather data were used to determine average dry weather flows and representative dry weather bacteria densities for calculation of existing loads and TMDLs. The dry weather data were further analyzed to evaluate the bacteria densities draining directly to Tecolote Creek and its tributaries.

There were five flow measurements collected at station MBW06 (Figure 4-1), the dry weather monitoring station closest to the mouth of Tecolote Creek. These flow measurements ranged from 0.12 cubic feet per second (cfs) to 0.81 cfs and had an average flow rate of 0.36 cfs (Table 4-5). This value is similar to the average dry weather flow for all monitoring stations in the watershed (0.30 cfs based on 25 samples collected at five stations), as indicated in Table 4-5. Because of the similarity, this flow value was incorporated into the existing load and TMDL calculations as the representative flow value for dry weather flow in Tecolote Creek.

Table 4-5. Instream Dry Weather Flow (cfs) Data Summary

	Station					
	MBW06	**MBW07**	**MBW08**	**MBW09**	**MBW10**	**All Stations**
Count	5	4	5	5	6	25
Minimum	0.12	0.02	0.02	0.01	0.08	0.01
Maximum	0.81	1.06	0.40	0.59	0.58	1.06
Mean	0.36	0.57	0.17	0.24	0.23	0.30
Median	0.33	0.60	0.09	0.20	0.18	0.24
Standard Deviation	0.28	0.47	0.16	0.24	0.19	0.28

Bacteria densities were analyzed and monitored at five locations in the watershed. The number of samples, minimum, maximum, and geometric mean, along with other summary statistics for TC, FC, and ENT are presented in Tables 4-6 through 4-8, respectively. These tables also present the percent exceedance of the dry weather numeric targets (section 3.2) based on geometric means for each station and indicator bacteria.

The TC exceedance frequencies were determined by using the REC-1 dry weather numeric targets (1,000 MPN/100mL), which are based on geometric means of five samples collected within a 30-day period. The results of these data analyses are presented in Table 4-6. The water quality data exceeded the REC-1 dry weather numeric targets 100 percent of the time at all five stations sampled.

Table 4-6. Instream Dry Weather Total Coliform (MPN/100mL) Data Summary

	Station				
	MBW06	**MBW07**	**MBW08**	**MBW09**	**MBW10**
Count	50	30	26	59	65
Minimum	959	700	2,602	1,246	1,313
Maximum	344,800	86,200	1,732,900	547,500	2,419,200
Mean	38,969	15,846	112,043	44,991	226,258
Geometric Mean	15,327	8,267	22,801	15,228	22,672
Standard Deviation	59,276	20,463	341,497	102,063	643,725
Number of Exceedance Calculations	38	13	6	47	53
% Exceedance of REC-1 Target[a]	100%	100%	100%	100%	100%

[a] REC-1 dry weather numeric target for total coliform (TC) is 1,000 MPN/100mL

The FC exceedance frequencies were determined by using the REC-1 dry weather numeric target (200 MPN/100mL), which is based on geometric means of five samples collected within a 30-day period. The results of these data analyses are presented in Table 4-7. The FC exceedance frequencies range from 0.0 to 88.7 percent. The two lowest exceedance frequencies occur along the main stem of Tecolote Creek, including the station closest to the mouth; however a station further upstream on the main channel (MBW10) exceeds the geometric mean WQO 88.7 percent of the time.

Table 4-7. Instream Dry Weather Fecal Coliform (MPN/100mL) Data Summary

	Station				
	MBW06	**MBW07**	**MBW08**	**MBW09**	**MBW10**
Count	50	30	26	59	65
Minimum	5	5	10	5	10
Maximum	8,664	3,873	8,664	104,624	1,732,870
Mean	348	232	848	3,343	41,512
Geometric Mean	61	60	185	263	608
Standard Deviation	1337	700	1,918	14,155	233,512
Number of Exceedance Calculations	38	13	6	47	53
% Exceedance of REC-1 Target[a]	2.6%	0.0%	83.3%	68.1%	88.7%

[a] REC-1 dry weather numeric target for fecal coliform (FC) is 200 MPN/100mL

The ENT exceedance frequencies were determined by using the REC-1 dry weather numeric target (33 MPN/100mL), which is based on geometric means of five samples collected within a 30-day period. Table 4-8 presents the ENT data analyses. These results indicate that the REC-1 numeric target for ENT is exceeded 100 percent of the time at all stations monitored.

Table 4-8. Instream Dry Weather Enterococcus (MPN/100mL) Data Summary

	Station				
	MBW06	**MBW07**	**MBW08**	**MBW09**	**MBW10**
Count	50	30	26	59	65
Minimum	10	40	52	5	63
Maximum	6,630	15,650	30,760	2,419,200	178,500
Mean	403	841	2,233	42,596	5,730
Geometric Mean	160	299	513	424	1,001
Standard Deviation	1,064	2,805	6,187	314,772	22,621
Number of Exceedance Calculations	38	13	6	47	53
% Exceedance of REC-1 Target[a]	100%	100%	100%	100%	100%

[a] REC-1 dry weather numeric target for *Enterococcus* (ENT) is 33 MPN/100mL

The TC, FC, and ENT results presented above confirm that Tecolote Creek is not meeting its REC-1 WQOs. In addition, results near the mouth of the creek were compared to REC-1 WQOs to evaluate the number of exceedances likely to occur at the outlet of the Tecolote Creek watershed during dry weather because high bacteria counts in the watershed generally lead to high bacteria counts downstream in Mission Bay. The REC-1 dry weather numeric target for TC was exceeded in 100 percent of the samples analyzed near the mouth of Tecolote Creek.

To determine the representative dry weather bacteria densities in Tecolote Creek for use in existing load calculations, flow-weighted average concentrations were calculated. These calculations used all observed bacteria concentrations that had corresponding flow measurements. There were a total of 25 samples that had both bacteria and flow results, distributed among the five sampling stations (Figure 4-1). Flow-weighted averages were calculated by multiplying each bacteria concentration with its associated flow. These 25 loads were then summed and divided by the sum of the 25 flow measurements. To calculate existing loads, these flow-weighted values were multiplied by the average dry weather flow described above (0.36 cfs). The estimated existing dry weather bacteria loads are presented in Table 4-9.

Table 4-9. Estimated Existing Dry Weather Loads

Pollutant	Flow (cfs)	Observed Flow-Weighted Average (MPN/100mL)	Daily Load (MPN/day)	Annual Load (billion MPN/year)
Total Coliform	0.36	46,550	410,039,357,716	126,292
Fecal Coliform	0.36	125	1,102,376,647	340
Enterococcus	0.36	714	6,285,014,608	1,936

Annual Load (billion MPN/year) = Flow (cfs) x Observed Flow-Weighted Average (MPN/100 mL) x (86,400 s/day) x (1000 mL/L) x (28.32 L/ft^3) x (308 dry days/critical year) ÷ 1,000,000,000

To further characterize bacteria densities in Tecolote Creek, data from several storm water outlets (illustrated by the blue triangles in Figure 4-1) were evaluated. Tables 4-10 through 4-12 summarize the TC, FC, and ENT results, respectively, at each station and at all stations combined. These data indicate that the dry weather urban runoff draining into Tecolote Creek and its tributaries frequently exceeds REC-1 numeric WQOs (exceedance frequencies range from 0 to 100 percent, depending on the station and indicator bacteria). In particular, station DW108 (Figure 4-1) has especially high TC concentrations (Table 4-10), while station DW275 (Figure 4-1) has high FC and ENT concentrations (Table 4-11 and Table 4-12). The only stations with zero percent exceedances were DW279 and DW280 (Figure 4-1). Only one dry weather drainage outlet sample was available at each of these stations. A total of five flow measurements were available, distributed among three stations. These flow measurements ranged from 0.04 to 0.56 cfs and had an average flow rate of 0.18 cfs, although this average rate is highly influenced by the 0.56 cfs measurement at DW108 (the second highest flow measurement was 0.12 cfs).

Comment [s3]: No triangles

Deleted: dollar signs

Table 4-10. Summary of Total Coliform Data (MPN/100mL) from Outlets Draining to Tecolote Creek (or its Tributaries)

	Station					
	DW108	**DW109**	**DW275**	**DW279**	**DW280**	**All Stations**
Count	3	3	3	1	1	11
Minimum	3,000	1,300	3,000	8,000	2,300	1,300
Maximum	300,000	70,000	90,000	8,000	2,300	300,000
Mean	147,667	26,100	33,333	8,000	2,300	57,418
Geometric Mean	50,133	8,604	12,364	8,000	2,300	13,534
Standard Deviation	148,648	38,125	49,116	N/A[b]	N/A	93,017
% Exceedance REC-1 target[a]	100%	100%	100%	100%	100%	100%

[a] REC-1 dry weather numeric target for total coliform (TC) is 1,000 MPN/100mL.
[b] N/A = not applicable. Geometric means could not be calculated because only one sample was available at this station.

Table 4-11. Summary of Fecal Coliform Data (MPN/100mL) from Outlets Draining to Tecolote Creek (or its Tributaries)

	Station					
	DW108	**DW109**	**DW275**	**DW279**	**DW280**	**All Stations**
Count	3	3	3	1	1	11
Minimum	20	230	1,100	140	40	20
Maximum	50,000	1,700	160,000	140	40	160,000
Mean	19,340	743	54,133	140	40	20,257
Geometric Mean	2,000	490	6,116	140	40	1,017
Standard Deviation	26,850	829	91,683	N/A[b]	N/A	48,637
% Exceedance REC-1 target[a]	67%	100%	100%	0%	0%	73%

[a] REC-1 dry weather numeric target for fecal coliform (FC) is 200 MPN/100mL.
[b] N/A = not applicable. Geometric means could not be calculated because only one sample was available at this station.

Table 4-12. Summary of Enterococcus Data (MPN/100mL) from Outlets Draining to Tecolote Creek (or its Tributaries)

	Station					
	DW108	**DW109**	**DW275**	**DW279**	**DW280**	**All Stations**
Count	3	3	3	1	1	11
Minimum	7,200	480	1,500	80	20	20
Maximum	34,000	10,000	140,000	80	20	140,000
Mean	17,067	4,160	48,767	80	20	19,098
Geometric Mean	13,477	2,125	10,027	80	20	2,608
Standard Deviation	14,731	5,114	79,028	N/A[b]	N/A	41,262
% Exceedance REC-1 target[a]	100%	100%	100%	100%	0%	91%

[a] REC-1 dry weather numeric target for *Enterococcus* (ENT) is 33 MPN/100mL.
[b] N/A = not applicable. Geometric means could not be calculated because only one sample was available at this station.

5 Source Analysis

The purpose of the source analysis is to identify and quantify the sources of bacteria to Tecolote Creek. Bacteria can enter surface waters from both point and nonpoint sources. Point sources typically discharge at a specific location from pipes, outfalls, and conveyance channels from, for example, municipal wastewater treatment plants or municipal separate storm sewer systems (MS4s). These discharges are regulated through waste discharge requirements (WDRs) that implement federal NPDES regulations issued by the State Water Board or the San Diego Water Board through various orders. Nonpoint sources are diffuse sources that have multiple routes of entry into surface waters. Some nonpoint sources, such as agricultural and livestock operations, are regulated under the Basin Plan's waste discharge requirement waiver policy (Waiver Policy).

Both in-stream and watershed data were used to identify potential sources and characterize the relationship between point and nonpoint source loadings and in-stream response, under both wet weather and dry weather conditions. During both wet weather and dry weather periods, multiple point and nonpoint sources of bacteria contribute to overall loads to threatened or impaired waterbodies. Bacteria are deposited both directly to the waterways and also onto land surfaces. Sources can include storm drain discharges, sewer line breaks, leaking septic systems, agricultural activities, deposit of waste from aquatic and terrestrial wildlife and pets, decaying matter, soil, and deposit of waste from encampments of homeless persons.

Sources of bacteria are the same under both wet weather and dry weather conditions. One exception may be eroded soils. Some studies suggest that eroded soils contribute significantly to wet weather bacteria signals in creeks, but not to dry weather signals (personal communication, Patricia A. Holden, U.C. Santa Barbara, CA 2007). However the methods of transport under the two conditions are very different. Wet weather loading is dominated by episodic storm flows that wash off bacteria that build up on the surface of all land use types in a watershed during dry periods. Dry weather loading is dominated by nuisance flows from urban land use activities such as car washing, sidewalk washing, and lawn over-irrigation, which pick up and transport bacteria into receiving waters. These types of nuisance flows are generally referred to as urban runoff. Because the relative loads from bacteria sources vary significantly between wet and dry weather conditions, load assessment required separate wet and dry weather analyses. For this reason, two distinct methodologies were used to assess bacteria loading and TMDLs. These are described in the Linkage Analysis in section 6.

5.1 Land Use / Bacteria Source Correlation

In this analysis, bacteria sources were quantified by land use type since bacteria loading can be highly correlated with land-use practices, according to Southern California Coastal Water Research Project's land use study in Los Angeles County. Some land use types, such as low and high density residential, produce high concentrations of bacteria while other land use types, such as military, produce relatively small concentrations of bacteria.

Since several land use types share hydrologic or pollutant loading characteristics, many were grouped into similar classifications, resulting in a subset of 13 categories for modeling. Selection of these land-use categories was based on the availability of monitoring data and literature values that could be used to characterize individual land use contributions and critical bacteria-contributing practices associated with different land uses. For example, multiple urban categories were represented independently (e.g., high density residential, low density residential, and commercial/institutional), whereas other natural categories were grouped.

5.1.1 Wet Weather Transport

During wet weather events, wash-off of bacteria from various land uses is considered the primary mechanism for transport of bacteria. After bacteria build up on the land surface as the result of various land sources and associated management practices (e.g., management of livestock in agricultural areas, pet waste in residential areas), many of the bacteria are washed off the surface during rainfall events. The amount of runoff and associated bacteria densities are therefore highly dependent on land use. This methodology of correlating land use to bacteria sources produced successful modeling results, despite the fact that some sources are distributed across several different land uses (i.e. wildlife inhabiting open space land use and also urbanized land uses such as high and low density residential).

Land use classifications were based on land use data from SANDAG and were grouped, where necessary, as described above. Pie charts were developed to show the relative bacteria loads by land use for the Tecolote Creek watershed (Appendix D) based on the wet weather model results.

5.1.2 Dry Weather Transport

During dry weather conditions, many streams in southern California, including Tecolote Creek, exhibit a sustained flow even if no rainfall has occurred for a significant period to provide runoff. These flows result from various urban land use practices that generate urban runoff, which enters storm drains and the creek. As these flows travel across lawns and urban surfaces, bacteria are carried from these areas to the receiving water. This was shown for Tecolote Creek in results of analyses of dry weather flow data (section 4.2.2).

5.2 Point Sources

Bacteria loads attributable to point sources are discharged in urban runoff from the following land use types:

- Low Density Residential;
- High Density Residential;
- Commercial/Institutional;
- Industrial/Transportation (excluding areas owned by Caltrans)
- Caltrans;

- Military; and
- Parks/Recreation.

These land use types were classified as generating point source loads because, although the bacteria sources on these land use types may be diffuse in origin, the pollutant loading is transported and discharged to receiving waters through MS4s. The principal MS4s contributing bacteria to receiving waters are owned or operated by either the local municipality or Caltrans.

5.3 Nonpoint Sources

Bacteria loads attributable to nonpoint sources are discharged in storm water runoff from the following land use types:

- Open Recreation; and
- Open Space.

These land use types were classified as generating nonpoint source loads because the loads are discharged in overland storm water runoff that is diffuse in origin, and are largely located in areas without constructed (man-made) MS4s or in areas upstream of MS4 networks.

6 Linkage Analysis

The analysis of the relationship between pollutant loading from the identified sources and the response of the waterbody to this loading is referred to as the linkage analysis. The purpose of the linkage analysis is to quantify the maximum allowable bacteria loading that can be received by a threatened or impaired waterbody and still attain the WQOs of the applicable beneficial uses. This numeric value is, in fact, the TMDL.

Because the TMDL calculations are based on beneficial uses and associated numeric WQOs, attainment of the TMDL numeric targets will result in attainment of water quality standards. After the TMDL for a waterbody is calculated, it is allocated to point and nonpoint sources. If the existing pollutant loading from the point and nonpoint sources exceeds their respective allocations, reductions required for individual controllable pollutant sources can be calculated to meet the TMDL, and thus water quality standards.

For this TMDL, a distinction is made between wet weather, or storm flow events and dry weather conditions because bacteria loads differ between the two weather scenarios, and implementation measures will be specific to wet and dry weather conditions. Two distinct approaches were used for calculating bacteria loads. Factors considered in selecting a modeling approach for calculating loading and TMDLs are described in section 6.1. For wet weather conditions, a dynamic model was selected to calculate loading during wet weather events. The selected wet weather modeling approach is discussed in section 6.2. For dry weather conditions, a model was not necessary because there was sufficient available observed data from Tecolote Creek to perform a statistical analysis to estimate dry weather loading, as discussed in section 6.3. These different approaches were used to calculate existing loading and TMDLs under wet weather and dry weather conditions. This information is presented in Tables 8-1 and 8-2.

6.1 Consideration Factors for Model Selection

In selecting an appropriate modeling approach for calculating loading and TMDLs, technical and regulatory criteria were considered. Technical criteria include the physical system in question, including watershed or stream characteristics and processes, and the constituent of interest, in this case, bacteria. Regulatory criteria include water quality standards (including beneficial uses and WQOs) or procedural protocol. Based on these considerations, an appropriate modeling approach was selected to simulate loading from wet weather events and during dry weather conditions in the Tecolote Creek watershed. The following discussion details the considerations in each of these categories.

6.1.1 Technical Criteria

There are four main technical criteria considered when selecting a modeling approach for loading and TMDL calculations: 1) physical domain, 2) source contributions, 3) critical conditions, and 4) model variables. Consideration of each criterion was critical in selecting the most appropriate modeling approach to address the types of sources and the numeric targets associated with the threatened or impaired waters.

6.1.1.1 Physical Domain

Representation of the physical domain is perhaps the most important consideration in the selection of a modeling approach for loading and TMDL calculations. The physical domain is the focus of the modeling effort. The physical domain typically consists of either the receiving water itself or a combination of the contributing watershed and the receiving water. Selection of the appropriate physical domain for modeling depends on the constituents and the conditions under which the stream exhibits impairment.

For a stream dominated by point source inputs that exhibits impairments under only low-flow conditions, a steady-state modeling approach is typically used. This type of modeling approach focuses on only in-stream (receiving water) processes during a user-specified condition. This approach uses a simple model or equation with a minimal number of variables, such as flow and bacteria density, to calculate the load and TMDL of a waterbody. In situations where sufficient data are available, a statistical analysis may be performed to estimate a steady-state bacteria load for dry weather conditions.

For streams affected additionally or solely by rainfall-driven flow and pollutant contributions, a dynamic modeling approach is recommended. Dynamic watershed models consider time-variable nonpoint source contributions from a watershed surface and/or subsurface. Some dynamic models consider monthly or seasonal variability, while others enable assessment of conditions immediately before, during, and after individual rainfall events. Dynamic models require a substantial amount of information regarding input parameters and data for calibration purposes.

For this project, under wet weather conditions Tecolote Creek was assumed to be dominated by rainfall-driven flow and pollutant contributions that are generally constant on an hourly time step and deposit directly to storm drains and receiving waters. Under dry weather conditions Tecolote Creek was assumed to be dominated by low-flow, steady-state conditions.

6.1.1.2 Source Contributions

Primary sources of pollution to a waterbody must be considered in the selection process. Accurately representing contributions from nonpoint sources and regulated point sources is critical in properly representing the system and ultimately evaluating potential load reduction scenarios.

Available water quality monitoring data were not sufficient to fully characterize all sources of bacteria in the watersheds draining to impaired waterbodies. However, analyses of the available data indicate that the main controllable sources are dry and wet weather urban runoff. A dynamic modeling approach was selected to calculate bacteria loading and develop bacteria TMDLs for Tecolote Creek to address the major source categories considered controllable during wet weather events for TMDL implementation purposes. Observed data from Tecolote Creek were analyzed for a steady-state approach to calculate bacteria loading and develop the bacteria TMDLs for dry weather conditions.

6.1.1.3 Critical Conditions

The goal of a TMDL analysis is to determine the assimilative capacity of a waterbody for a pollutant and to identify potential allocation scenarios that will enable the waterbodies to achieve water quality standards (beneficial uses and WQOs). The critical condition is the set of environmental conditions for which controls designed to protect water quality will ensure attainment of objectives for all other conditions. Thus, the critical condition is typically the period of time and location in which the waterbody exhibits the most vulnerability.

Critical conditions are accounted for in this project by way of using separate modeling approaches for wet weather and dry weather conditions. In addition, to ensure that WQOs are met in the threatened or impaired waterbodies, a critical period associated with extreme rainfall conditions was selected for watershed modeling analysis.

6.1.1.4 Model Variables

Another important consideration in model selection and application are the model variables required to assess and/or simulate the fate and transport of pollutant(s) in the watershed and/or waterbody. Selection of the model state variables is a critical part of developing a model. The more state variables included, the more complex the model becomes, and the more difficult the model is to apply and calibrate. However, if key state variables are omitted from the model, the simulation might not include all the necessary aspects of the modeled system and might produce unrealistic results. A delicate balance must be met between minimum number of variables and maximum applicability of the model.

The focus of this TMDL analysis is on TC, FC, and ENT bacteria. In-stream bacteria dynamics can be extremely complex, and accurate estimation of bacteria concentrations relies on a host of interrelated environmental variables. Environmental variables that can affect the survival of bacteria include soil moisture content, pH, solar radiation, and available nutrients. Bacteria concentrations in the water column are also influenced by die-off, re-growth, partitioning of bacteria between water and sediment during transport, as well as bacteria and sediment settling and re-suspension of bottom materials.

First-order die-off is likely the most important dynamic process to simulate in Tecolote Creek, despite observations that bacteria re-grow in low flow conditions. The limited data available provide few insights into which of the other factors listed above might be most influential on bacterial behavior for the model. The available observed data for wet weather events are relatively limited, but useful in the development of a dynamic modeling approach that can be used for predicting bacteria loading and TMDLs under wet weather events. For dry weather, there are sufficient data available to perform statistical analyses to calculate average flows and bacteria densities, which are used in a simple steady-state model or equation, to calculate bacteria loading and TMDLs under dry weather conditions. A description of the assumptions associated with the wet weather and dry weather modeling approaches is described in Appendix E.

6.1.2 Regulatory Criteria

The Basin Plan establishes, for all waters in the San Diego Region, the beneficial uses for each waterbody to be protected, the numeric WQOs that protect those uses, and an implementation plan that accomplishes those objectives. A properly designed and applied model provides the source-response linkage component for each waterbody and enables accurate assessment of assimilative capacities. A stream's assimilative capacity is determined by assuming adherence to WQOs.

The modeling approach must enable direct comparison of model results to in-stream concentrations and allow for the analysis of the duration of those concentrations. For the watershed loading analysis and implementation of measures to reduce pollutant loads, it is also important that the modeling approach enable examination of gross land use loading as well as in-stream concentrations.

6.2 Wet Weather Modeling Approach

During wet weather events, sources of bacteria are associated with wash-off of bacteria accumulated, or built up, on the land surface. Bacteria are delivered to receiving waters through creeks and storm water collection systems. In this analysis, bacteria sources were linked to specific land use types with higher relative bacteria accumulation rates because they are more likely to deliver bacteria to waterbodies through storm water collection systems. To assess the link between sources of bacteria and the impaired waters, a modeling system that simulates the build-up and wash-off of bacteria and the hydrologic and hydraulic processes that affect delivery was used. The wet weather modeling approach assumes the following:

- All sources can be represented through build-up/wash-off of bacteria from specific land use types.
- The discharge of sewage is zero. Sewage spill information was reserved for use during the calibration process to account for observed spikes in bacteria indicators, as applicable; however, the calibration process did not necessitate removal of any wet weather data considered to be affected by sewage spill information. In other words, data from wet weather events used for calibration were not indicative of sewage spills.
- For TMDL numeric target assessment, the critical point was assumed to be the point upstream of where Tecolote Creek initially mixes with Mission Bay.

The wet weather modeling approach chosen for use in this project is based on the application of the USEPA's Loading Simulation Program in C++ (LSPC) model to estimate bacteria loading from Tecolote Creek. LSPC is a recoded C++ version of the USEPA's Hydrological Simulation Program–FORTRAN (HSPF) that relies on fundamental (and USEPA-approved) algorithms. LSPC models have been successfully calibrated and applied in Southern California for multiple pollutants, including watersheds of Santa Monica Bay (Los Angeles Water Board, 2002), Ballona Creek

(Ackerman et al., 2005; Los Angeles Water Board, 2005a), Los Angeles River (Los Angeles Water Board, 2005b), San Gabriel River (Tetra Tech, Inc, 2005a), San Jacinto River (SAWPA, 2003; Tetra Tech, Inc, 2005b), and multiple watersheds draining to impaired beaches of the San Diego Region for Bacteria TMDL Project I (San Diego Water Board, 2007). Many of these models were applied to support TMDL development and the projects are in varying stages of the TMDL approval process (including several adopted TMDLs).

The Tecolote Creek watershed model that has been developed is a direct application of the regionally calibrated models from Bacteria TMDL Project I (San Diego Water Board, 2007). Regional calibration involved determining a single set of hydrologic and water quality parameters that closely predicted observed stream flow and bacteria densities in all watersheds of the region. Data for watersheds throughout the region were used to compare with model output during calibration and validation of the Bacteria TMDL Project I models (San Diego Water Board, 2007).

The Tecolote Creek watershed was not included for assessment of bacteria loads during the development of Bacteria TMDL Project I because watersheds draining to impaired bays were excluded from that study. This current project therefore addresses the bacteria loads to Tecolote Creek, which ultimately discharges into Mission Bay. This process involves model configuration, subwatershed delineation, application of the regional parameters to the Tecolote Creek watershed, continuous simulation of flow and water quality, and comparison of model results to observed flow and water quality data, which are discussed in Appendix C. Additional assumptions for wet weather modeling can be found in Appendix E.

6.3 Dry Weather Analysis Approach

Bacteria densities in receiving water during dry weather conditions are extremely variable in nature. Sufficient dry weather stream flow and water quality data were available to perform statistical and spatial analyses for loading assessment. The data were analyzed to determine average flow and bacteria densities in Tecolote Creek (based on flow-weighted average concentrations). The average flow and bacteria densities were then used to estimate existing dry weather bacteria loadings, to calculate TMDLs based on average flow and the numeric targets, and to develop necessary load allocations for TMDL development.

7 Total Maximum Daily Load, Existing Load, and Load Reduction Calculations

The calibrated wet weather model simulated flow and bacteria densities for use in estimating existing wet weather bacteria loads to Tecolote Creek. Existing loads during dry weather conditions were estimated from available stream flow and water quality monitoring data. Estimated existing loads were compared to TMDLs, and necessary reductions were quantified.

7.1 Wet Weather Loading Analysis

The LSPC model was used to estimate existing wet weather bacteria loads at critical conditions for comparison to wet weather numeric targets and determination of required load reductions for Tecolote Creek. The hydrology validation results for the LSPC model are shown in Appendix C. A comparison of the modeling results to observed bacteria densities are also shown in Appendix C.

7.1.1 Identification of the Critical Wet Weather Condition

To ensure that WQOs are met in impaired waterbodies during wet weather conditions, a period associated with extreme wet conditions was selected for TMDL calculations. This extreme wet period, or critical wet weather condition, was selected by reviewing data from multiple rainfall gages in the San Diego Region over a recent 15-year period (1990 through 2005). The wettest year, 1993, was selected as the critical wet period for assessment of extreme wet weather loading conditions. Statistically, 1993 corresponds to the 93rd percentile of annual rainfalls for those 15 years measured at Lindbergh Field. Selection of this year was consistent with studies performed by the Southern California Coastal Water Research Project (SCCWRP). An analysis of rainfall data for the Los Angeles Airport from 1947 to 2000 shows that 1993 was the 90th percentile year; meaning 90 percent of the years between 1947 and 2000 had less annual rainfall than 1993 (Los Angeles Water Board, 2002).

7.1.2 Wet Weather Load Estimation

Estimation of existing wet weather loading to the impaired waterbodies required use of a dynamic model to predict flows and bacteria densities. The dynamic model-simulated watershed processes, based on observed rainfall data as model input, provided temporally variable load estimates for the critical period. These load estimates were simulated using calibrated, land-use-specific processes associated with hydrology and build-up and wash-off of bacteria from the land surface. Transport processes of bacteria loads from the source to the impaired waterbodies were also simulated in the model with a first-order loss rate based on literature values.

For estimation of bacteria loading during wet weather events, simulations were performed using local rainfall data. During the critical wet year, 57 wet days were observed at the Lindbergh Field weather station, which was used to represent the Tecolote Creek watershed. Only the dynamic model-predicted flows and bacteria densities for wet days were considered in estimating existing loads and TMDLs.

7.1.3 Identification of Allowable Exceedance Days

The numeric targets used to estimate both interim and final TMDLs are discussed in section 3. For the interim implementation period, the exceedance frequency from a reference system was used to calculate the total number of allowable days that REC-1 numeric targets may be exceeded. Calculations were performed by multiplying the allowable exceedance frequency (22 percent) by the number of wet days for the critical period, or critical wet year. In the critical wet year, 1993, there were 57 wet days for the Tecolote Creek watershed. Thus, there are 13 allowable exceedance days (57 days x 22 percent) for the Tecolote Creek watershed.

7.1.4 Critical Points for TMDL Calculation

TMDLs and existing loads were calculated from modeled flow and bacteria densities at a node in the model representing the culmination point at the bottom of the watershed (i.e., discharge to Mission Bay). This critical point in the model represents the lowest point in the watershed where Tecolote Creek discharges, and before mixing with Mission Bay and dilution takes place. This critical point is a conservative location for assessment of water quality conditions, based on high bacteria loads predicted at that location.

Although this critical point for water quality assessment is utilized to calculate the bacteria loads discharged from the watershed, compliance with WQOs must be assessed and maintained for all segments of Tecolote Creek to ensure that impairments of beneficial uses do not occur. The REC-1 beneficial use applies throughout all segments of the Tecolote Creek watershed and at the mouth of Tecolote Creek as it flows into Mission Bay. Therefore, the location of the critical point will allow us to assess the water quality required to attain WQOs for both beneficial uses and waterbodies.

7.1.5 Calculation of Wet Weather TMDLs and Load Reductions

Estimated existing wet weather bacteria loads were compared to wet weather TMDLs through the use of load-duration curves. Load-duration curves are bar graphs that show the daily bacteria loads in an order based on the percentile rank of the associated modeled flow. Load-duration curves were produced for each type of indicator bacteria. These graphs formed the basis for the existing load and TMDL calculations as described below. This methodology is also described in Appendix D.

The following steps were taken to develop the interim load-duration curves:

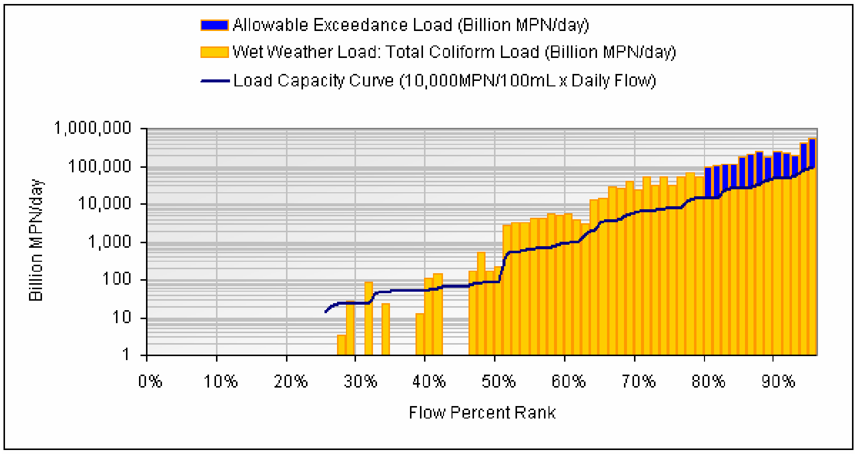
1. Calculation of daily existing wet weather loads – daily existing wet weather loads were calculated by multiplying the daily modeled flow with daily modeled bacteria density, then ranked based on their associated flow percentile;
2. Calculation of allowable wet weather load – daily modeled wet weather flows were multiplied by the wet weather numeric targets to create a numeric target line, or load capacity curve, across the load-duration curves;

3. Determination of the interim allowable wet weather exceedance loads using the reference system approach – allowable wet weather exceedance loads correspond to the exceedance loads (loads above the numeric target line) from the 13 (22 percent of the 57 wet days during the critical wet year of 1993) highest allowable exceedance days (shown in blue in the interim load-duration curves);
4. Calculation of interim wet weather TMDL – the interim wet weather TMDL is the sum of the allowable wet weather loads (sum of bar segments below the numeric target line) from Step 2 and the allowable wet weather exceedance loads (sum of blue bars above numeric target line) from Step 3; and
5. Calculation of interim non-allowable wet weather exceedance loads – the interim non-allowable wet weather exceedance loads correspond to the total existing wet weather loads (sum of all the bars in the load-duration curves) from Step 1 minus the interim wet weather TMDL from Step 4.

The following steps were taken to develop the final load-duration curves:

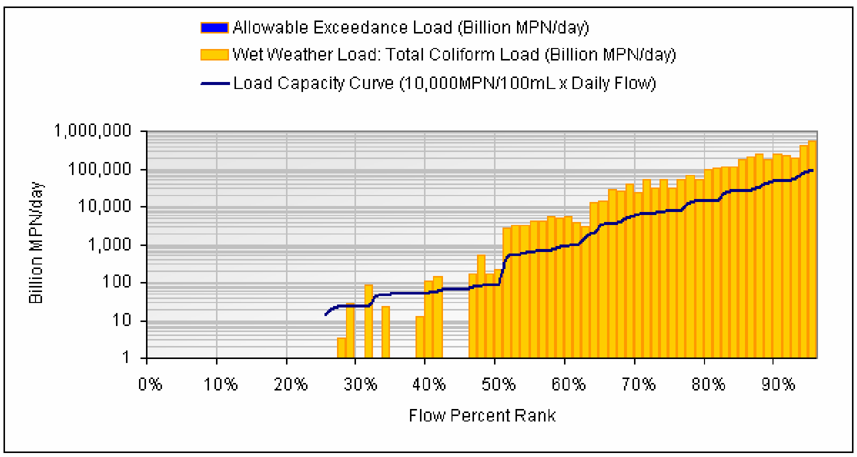
1. Calculation of daily existing wet weather loads – daily existing wet weather loads were calculated by multiplying the daily modeled flow with daily modeled bacteria density, then ranked based on their associated flow percentile;
2. Calculation of the final wet weather TMDL – daily modeled flows were multiplied by the wet weather numeric targets to create a numeric target line, or load capacity curve, across the load-duration curves, with the bar segments below the curve corresponding to the final wet weather TMDL; and
3. Calculation of final non-allowable wet weather exceedance loads – the final non-allowable exceedance loads, or required wet weather load reduction, correspond to the total existing wet weather loads (sum of all the bars on the load-duration curves) from Step 1 minus the allowable wet weather loads (sum of bars below the numeric target line), or final wet weather TMDL, from Step 2.

The load-duration curves graphically show the existing wet weather loading, allowable loading (or TMDL), and load reduction required for each indicator bacteria (TC, FC, and ENT). This allows estimated existing bacteria loads to be compared to interim and final numeric targets. Load-duration curves and TMDL calculations for Tecolote Creek for interim and final numeric targets are provided in Figures 7-1 through 7-6 for all three indicator bacteria.



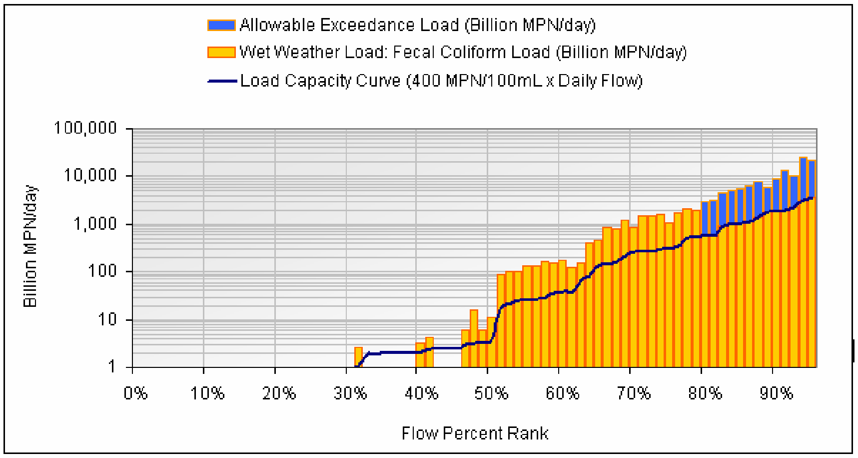
Total Coliform Loading Summary	Value	Units
Number of Exceedence Days (Bars with Segment above LC Curve)	44	None
Allowable Wet Day Exceedances (Bars with Blue Segments)	13	None
Excess Wet Day Exceedances	31	None
Total Load for Existing Condition (All Bar Segments)	3,400,693	Billion MPN/Year
Allowable Load (Bar Segments under LC Curve)	627,552	Billion MPN/Year
Allowable Exceedance Load (Blue Bar Segments)	2,348,125	Billion MPN/Year
Exceedance Load (Yellow Bar Segments above LC Curve)	425,531	Billion MPN/Year
Required Annual Load Reduction	12.5%	Percentage

Figure 7-1. Load duration curve for interim total coliform TMDL calculations



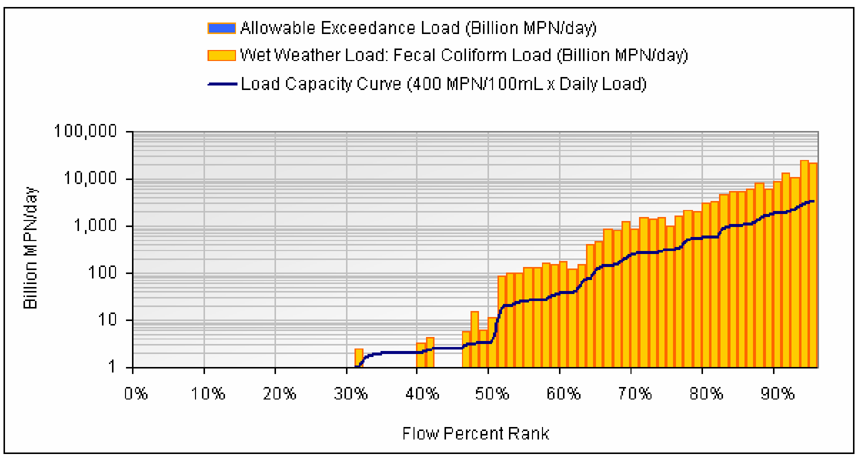
Total Coliform Loading Summary	Value	Units
Total Load for Existing Condition (All Bar Segments)	3,400,693	Billion MPN/Year
Allowable Load (Bar Segments under LC Curve)	627,552	Billion MPN/Year
Exceedance Load (Yellow Bar Segments above LC Curve)	2,773,141	Billion MPN/Year
Required Annual Load Reduction	81.5%	Percentage

Figure 7-2. Load duration curve for final total coliform TMDL calculations



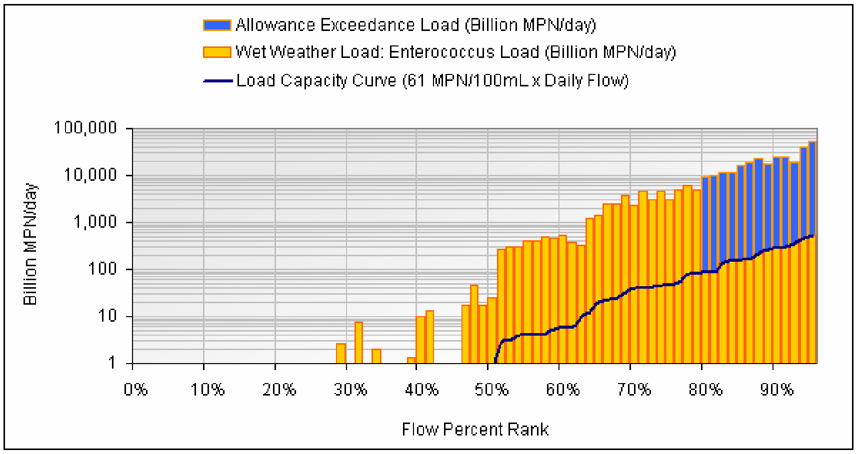
Fecal Coliform Loading Summary	Value	Units
Number of Exceedence Days (Bars with Segment above LC Curve)	43	None
Allowable Wet Day Exceedances (Bars with Blue Segments)	13	None
Excess Wet Day Exceedances	30	None
Total Load for Existing Condition (All Bar Segments)	139,585	Billion MPN/Year
Allowable Load (Bar Segments under LC Curve)	25,102	Billion MPN/Year
Allowable Exceedance Load (Blue Bar Segments)	101,031	Billion MPN/Year
Exceedance Load (Yellow Bar Segments above LC Curve)	13,472	Billion MPN/Year
Required Annual Load Reduction	9.7%	Percentage

Figure 7-3. Load duration curve for interim fecal coliform TMDL calculations



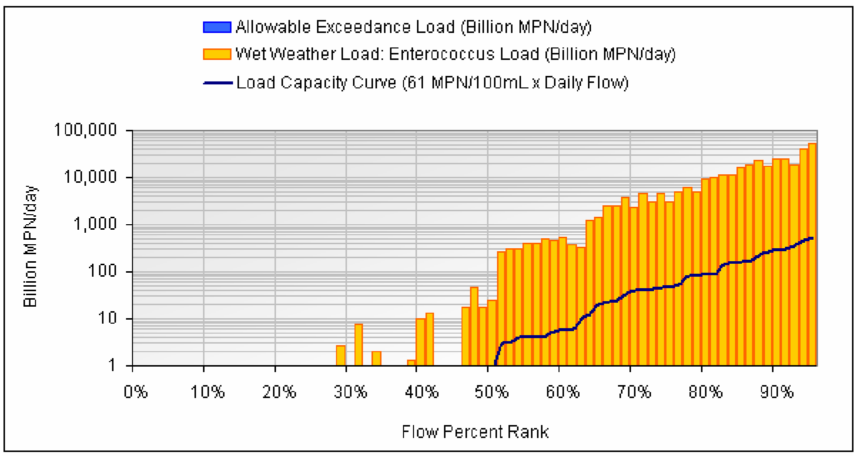
Fecal Coliform Loading Summary	Value	Units
Total Load for Existing Condition (All Bar Segments)	139,585	Billion MPN/Year
Allowable Load (Bar Segments under LC Curve)	25,102	Billion MPN/Year
Exceedance Load (Yellow Bar Segments above LC Curve)	114,504	Billion MPN/Year
Required Annual Load Reduction	82.0%	Percentage

Figure 7-4. Load duration curve for final fecal coliform TMDL calculations



Enterococcus Loading Summary	Value	Units
Number of Exceedence Days (Bars with Segment above LC Curve)	47	None
Allowable Wet Day Exceedances (Bars with Blue Segments)	13	None
Excess Wet Day Exceedances	34	None
Total Load for Existing Condition (All Bar Segments)	327,545	Billion MPN/Year
Allowable Load (Bar Segments under LC Curve)	3,828	Billion MPN/Year
Allowable Exceedance Load (Blue Bar Segments)	274,787	Billion MPN/Year
Exceedance Load (Yellow Bar Segments above LC Curve)	48,933	Billion MPN/Year
Required Annual Load Reduction	14.9%	Percentage

Figure 7-5. Load duration curve for interim Enterococcus TMDL calculations



Enterococcus Loading Summary	Value	Units
Total Load for Existing Condition (All Bar Segments)	327,545	Billion MPN/Year
Allowable Load (Bar Segments under LC Curve)	3,828	Billion MPN/Year
Exceedance Load (Yellow Bar Segments above LC Curve)	323,719	Billion MPN/Year
Required Annual Load Reduction	98.8%	Percentage

Figure 7-6. Load duration curve for final Enterococcus TMDL calculations

On each load-duration curve, much of the lower range of flow has no associated bacteria loads. This is due to model-predicted flows or bacterial concentrations close to zero. Although days were categorized as wet periods based on a criterion associated with rainfall (0.2 inches or more of rainfall and the following 72 hours), some of these days may actually have been dry in terms of streamflow (some streams may return to base flow conditions within 72 hours following a rainfall event), leading to poor modeling results. For this reason, bacteria loading during dry weather (low flow conditions) was analyzed separately.

7.1.6 Margin of Safety

Once TMDLs are calculated, they must be assigned a margin of safety (MOS). There are two ways to incorporate the MOS: (1) implicitly incorporate the MOS using conservative model assumptions to develop allocations and (2) explicitly specify a portion of the total TMDL as the MOS and use the remainder for allocations (USEPA, 1991). For wet weather TMDLs, some general assumptions were made regarding overall conditions facilitating bacteria subsistence and growth, and conditions affecting bacteria die-off. These assumptions are conservative in that they are protective of water quality. The following examples describe the conservative assumptions that constitute the implicit MOS for the wet weather TMDLs.

- *Critical Point for Wet Loading Assessments* - For existing wet load and TMDL calculations, the water quality at a *critical point* or location in the impaired Tecolote Creek has been compared to TMDL targets for assessment of reductions of pollutant loads to meet TMDLs. A critical point was selected at the mouth of the impaired creek segment. This critical point is a conservative location for assessment of water quality conditions, based on high bacteria loads predicted at that location. This approach provides an implicit MOS to ensure protection of the beneficial uses of the creek and downstream Mission Bay under critical conditions.
- *Wet Weather TMDL Numeric Targets* – For wet weather conditions, numeric targets are based on the single sample maximum WQOs in the Basin Plan. Because bacteria in wet weather runoff and streamflows have a quick travel time, and therefore, a short residence time in the waterbodies, the single-sample maximum WQOs were determined to be most appropriate for calculating the wet weather TMDLs.
- *Wet Weather Critical Condition* – The critical wet condition was selected as the wettest year observed over the past 15 years (1990 through 2005) at Lindbergh Field. This resulted in selection of 1993 as the critical wet year for assessment of wet weather loading conditions. Statistically, 1993 is in the 93rd percentile of annual rainfalls over the past 15 years. Because of the large amount of rainfall, bacteria loads are assumed higher in 1993 than another year with less rainfall.

7.1.7 Seasonality

Through simulation of an entire critical wet year, daily wet weather loads were estimated for all seasons of that year and compared to TMDLs to determine necessary load reductions. Model simulation of a full year accounted for seasonal variations in rainfall, evaporation, and associated impacts on runoff and transport of bacteria loads to receiving waters. Although large storms in the wet season of the critical year were associated with large volumes of runoff that transported large bacteria loads, smaller storms during the dry season (April to October) also provided large bacteria loads resulting from wash-off of bacteria that had accumulated on the surface during the preceding extended dry period. For estimating bacteria loads during dry weather conditions, a separate dry weather modeling approach was used (see section 7.2).

7.2 Dry Weather Loading Analysis

Analyses of available stream flow and water quality data were used to estimate average existing bacteria loads during dry weather conditions (based on flow-weighted average concentrations) for comparison to dry weather numeric targets and determination of required load reductions for Tecolote Creek.

7.2.1 Dry Weather Load Estimation

In order to be consistent with the wet weather modeling approach, dry days from the critical wet year, identified as 1993, were assessed. There were 308 dry days in 1993 for the Tecolote Creek watershed. For dry weather, there is sufficient dry weather stream flow and water quality data available to perform statistical analyses to calculate average flows and bacteria densities. Because dry weather loading was estimated using an average flow, there is no critical dry weather period.

The existing dry weather bacteria load is calculated based on the average flow and flow-weighted dry weather bacteria loading conditions resulting from various urban land use practices (e.g., runoff from lawn irrigation or sidewalk washing). An equation representative of dry weather flow and bacteria loading conditions is used to calculate bacteria loading and TMDLs under dry weather conditions. The result of this calculation is a constant, or steady-state, dry weather bacteria load from the Tecolote Creek watershed.

7.2.2 Critical Points for TMDL Calculation

Consistent with the approach used for wet weather analysis, TMDLs were calculated based on flow and bacteria density at the *critical point*, or the watershed mouth. The critical point represents the lowest point in the Tecolote Creek watershed where the creek discharges, and before mixing with Mission Bay and dilution takes place. This critical point is a conservative location for assessment of water quality conditions based on high bacteria loads predicted at that location.

Although this critical point for water quality assessment is utilized for TMDL analysis, compliance to WQOs must be assessed and maintained for all segments of Tecolote Creek to ensure that impairments of beneficial uses are not observed. The REC-1 beneficial use applies throughout all segments of Tecolote Creek watershed including the mouth of Tecolote Creek as it flows into Mission Bay. Therefore, the location of the critical point will be able to assess the water quality required to attain WQOs for the creek and the mouth of Tecolote Creek.

7.2.3 Calculation of Dry Weather TMDLs and Load Reductions

Estimated existing dry weather bacteria loads were compared to dry weather TMDLs to calculate load reductions required under dry weather conditions. This methodology is also described in Appendix D. The following steps were taken to calculate dry weather TMDLs and load reductions:

1. Calculation of daily existing dry weather loads – existing dry loads were calculated by multiplying the average daily dry weather flow with the flow-weighted average daily dry weather bacteria density with the number of dry weather days, 308, in the critical wet year;
2. Calculation of the dry weather TMDL – the dry weather TMDL was calculated by multiplying the average daily dry weather flow with the applicable dry weather numeric targets, in the critical wet year, with the number of days in a month, 30; and
3. A 10 percent explicit margin of safety was included in the dry weather TMDL analysis to account for uncertainty in the analyses (see Section 7.2.4). This MOS was calculated by multiplying the dry weather TMDL from Step 2 by 10 percent.
4. Calculation of dry weather exceedance loads – the dry weather exceedance loads, or required dry weather load reduction, correspond to the difference between the estimated existing dry weather bacteria loads from Step 1 and the dry weather TMDL minus the MOS from Steps 2 and 3, respectively.

The reference system approach was not used for dry weather TMDL analysis, therefore there was no allowable dry weather exceedance load calculated. Dry weather TMDLs are based on REC-1 numeric targets for TC, FC, and ENT. The FC and ENT targets apply along the length and mouth of Tecolote Creek. The TC target applies to the mouth of Tecolote Creek only.

7.2.4 Margin of Safety

The dry weather TMDLs incorporated both an implicit and explicit MOS. The implicit MOS was included through application of conservative assumptions throughout TMDL development. Conservative assumptions imply that worst case conditions exist in terms of estimated existing bacteria loading. The following list describes the conservative assumptions that constitute the implicit MOS for the dry weather TMDLs.

- *Calculation of Existing Loads* – For existing load calculations, several analyses were performed to determine the representative bacteria concentrations for existing conditions. A flow-weighted average approach was selected because it maximized available data, while proving more conservative than a geometric mean approach.
- *Load Reduction Calculations* – For existing dry load and TMDL calculations, the flow weighted average bacteria concentrations in Tecolote Creek have been compared to TMDL targets for assessment of reductions of pollutant loads to meet TMDLs. Calculating dry loading using flow weighted averages provides an

implicit MOS to ensure protection of the beneficial uses of the creek and downstream Mission Bay under critical conditions.

- *Dry Weather TMDL Numeric Targets* – For dry weather conditions, the 30-day geometric mean was used as a numeric target to calculate TMDLs. Because of the constant nature of the bacteria loads in the dry weather analysis, compliance with the 30-day geometric mean WQOs provides assurance that TMDLs will result in the protection of beneficial uses by stressing the importance of maintaining sustained safe levels of bacteria densities over all dry periods.

To account for any additional uncertainty in the dry weather analyses, a 10 percent explicit MOS was also incorporated in the TMDL.

7.2.5 Seasonality

Seasonal analyses of bacteria levels in Tecolote Creek were specific to wet and dry seasons, when loadings to the receiving waters can vary considerably. The dry weather analysis approach used available observed data to calculate an average flow from the Tecolote Creek watershed during dry weather conditions. The dry weather approach assesses constant bacteria loading and TMDLs during dry weather conditions. For estimating bacteria loads during wet weather conditions, a separate wet weather modeling approach was used (see Section 7.1).

8 Total Maximum Daily Loads and Allocations to Sources

The TMDL for a given pollutant within a waterbody is the total amount of a pollutant that can be assimilated by the receiving waterbody while still achieving the WQOs for the designated beneficial uses. TMDLs can be expressed on a mass-loading basis (e.g., numbers of bacteria colonies per year) or as a concentration in accordance with federal regulations.[9] Once calculated, the TMDL is set equal to the sum of individual waste load allocations (WLAs) for point sources, and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, the definition of a TMDL is represented by the following equation:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

The bacteria WQOs for REC-1 beneficial use of Tecolote Creek are used for the development of bacteria TMDLs. When developing a TMDL, allowable loadings from pollutant sources must be established that do not cumulatively amount to more than the TMDL. This provides the basis for establishing water quality-based controls.

For this project, TMDLs are expressed as number of bacteria colonies per year (billion MPN/year) for wet weather TMDLs and per month for dry weather TMDLs. This approach was previously used to express bacteria TMDLs in several beaches and creeks in the San Diego Region (San Diego Water Board, 2007). In order to measure bacteria loading, both flow rates and bacteria densities must be measured at the critical point. When multiplied together, these two parameters result in bacteria loading, or the number of bacteria colonies measured per unit time.

$$\textit{Bacteria Loading} = \textit{flow rate}\,(\textit{volume} / \textit{time}) \times \textit{bacteria density}\,(\textit{number of colonies} / \textit{volume})$$

Estimation of bacteria loading to determine compliance with the TMDLs may or may not be required from dischargers. Method(s) of compliance will be determined upon issuance, re-issuance or amendment of applicable WDRs, enforcement of waivers, or other appropriate means of regulation, and/or enforcement.

8.1 Summary of Technical Approach for TMDL Calculations

TMDLs were calculated based on predicted flow and bacteria density at the watershed critical point for both wet weather and dry weather conditions. The calculations and technical approaches were different for the two conditions.

8.1.1 Summary of Wet Weather TMDLs

For wet weather conditions, TMDLs were calculated for interim and final implementation phases, and divided among point sources as WLAs and nonpoint sources as LAs. Interim wet weather TMDLs were calculated using wet weather numeric targets equal to

[9] Code of Federal Regulations title 40, volume 21, section 130.2(i), revised July 1 2007.

the REC-1 bacteria WQOs in conjunction with a reference system approach. Final wet weather TMDLs were calculated using wet weather numeric targets equal to the single sample maximum REC-1 bacteria WQOs.

Interim TMDLs for wet weather were calculated by applying the reference system approach, which takes into consideration loading of bacteria from natural sources within the watershed. The reference system approach was used to calculate wet weather TMDLs for the interim implementation period, only. Although the San Diego Water Board recognizes that the reference system approach is appropriate since watersheds receive bacterial loadings from natural sources, final TMDLs must adhere to the existing WQOs in the Basin Plan, without including an exception from these sources. This is because, unlike the Los Angeles Water Board, the San Diego Water Board does not have implementation provisions for a reference system approach in its Basin Plan.

Federal regulations require TMDLs to include individual WLAs for each point source.[10] The point sources identified in Tecolote Creek were MS4s and Caltrans, although other point sources of bacteria may exist. The USEPA's permitting regulations require municipalities to obtain NPDES requirements for all storm water discharges from MS4s. The existing loads estimated were solely the result of watershed runoff, not other types of point sources. WLAs were assigned to municipalities (the City of San Diego) and Caltrans.

Comment [s4]: Proof read citation?

TMDLs must also include LAs for each nonpoint source. LAs were divided into non-controllable and controllable categories. Non-controllable nonpoint sources can include bacteria generated in open recreation and open space land uses. Controllable nonpoint sources can include discharges from agricultural facilities and livestock operations which are quantified by the agriculture, dairy/intensive livestock, and horse ranches land use categories. There is one animal operation in the watershed on the campus of Mesa College which can be regulated either as a non-point source under the waivers for animal feed operations, or under the small MS4 requirements for Mesa College.

8.1.2 Summary of Dry Weather TMDLs

For dry weather conditions, TMDLs were calculated using dry weather numeric targets equal to the REC-1 geometric mean WQOs rather than the single sample maximum WQOs. The reference system approach was not utilized in calculating dry weather TMDLs.

Unlike wet weather loading, which is caused by storm events, dry weather loading is dominated by nuisance flows from urban land use activities such as car washing, sidewalk washing, and lawn over-irrigation, which pick up and transport bacteria into receiving waters. These types of nuisance flows are referred to as urban runoff.

Because urban runoff is overwhelmingly the main source of bacteria loading during dry weather conditions, the dry weather TMDLs were allocated solely to MS4s. Allocations

---

[10] Code of Federal Regulations Title 40, Volume 21, section 130.7, revised July 1, 2007.

for nonpoint sources were unnecessary since land uses associated with these sources generally do not generate runoff to receiving water during dry weather conditions. Additionally, dry weather loads from Caltrans highways were assumed to be insignificant because during dry periods there is no significant urban runoff from Caltrans owned roadway surfaces.

TMDLs and associated WLAs and LAs are presented in Tables 8-1 through 8-3 for interim and final TMDLs. These tables also present wet and dry weather percent reductions based on their respective analyses. Appendix D describes how these values were calculated and also provides relative land use loads that were used to calculate load and wasteload allocations and reductions for specific dischargers, as appropriate.

Table 8-1. Interim Wet Weather TMDLs for Total Coliform, Fecal Coliform and Enterococcus Expressed as an Annual Load

Pollutant	Existing Load	Interim TMDL[a]	Wasteload Allocations				Load Allocations	
			Municipal MS4s		Caltrans[b]		Open Space/Rec[b]	
	Billion MPN/year	Billion MPN/year	Billion MPN/year	Percent Reduction	Billion MPN/year	Percent Reduction	Billion MPN/year	Percent Reduction
Total Coliform	3,400,693	2,975,678	2,312,857	15.5%	12,459	0%	650,362	0%
Fecal Coliform	139,585	126,133	65,023	17.1%	283	0%	60,827	0%
Enterococcus	327,545	278,615	207,207	19.1%	585	0%	70,823	0%

Abbreviations:
MPN: Most Probable Number (of bacteria colonies)
MS4s: Municipal Separate Storm Water Sewer Systems
TMDL: Total Maximum Daily Load

Notes:
a Interim wet weather TMDL based on single sample maximum REC-1 water quality objectives (WQOs) and includes the bacteria load that can be attributed to natural sources through the reference system approach. The interim wet weather TMDL corresponds to the sum of the bar segments below the numeric target line plus the blue bar segments above the numeric target line in the interim load-duration curves in Figures 7-1, 7-3 and 7-5.
b No reductions for Caltrans and Open Space/Rec categories because allocations are equal to existing loads.

Table 8-2. Final Wet Weather TMDLs for Total Coliform, Fecal Coliform and Enterococcus Expressed as an Annual Load

Pollutant	Existing Load	Final TMDL	Wasteload Allocations				Load Allocations	
			Municipal MS4s[c]		Caltrans[a]		Open Space/Rec[a]	
	Billion MPN/year	Billion MPN/year	Billion MPN/year	Percent Reduction	Billion MPN/year	Percent Reduction	Billion MPN/year	Percent Reduction
Total Coliform	3,400,693	627,552[b]	0	100%	12,459	0%	650,362	0%
Fecal Coliform	139,585	25,102	0	100%	283	0%	60,827	0%
Enterococcus	327,545	3,828	0	100%	585	0%	70,823	0%

Abbreviations:
MPN: Most Probable Number (of bacteria colonies)
MS4s: Municipal Separate Storm Water Sewer Systems
TMDL: Total Maximum Daily Load

Notes:
a No reductions for Caltrans and Open Space categories because allocations are equal to existing loads.
b Final wet weather TMDL based on single sample maximum REC-1 water quality objective (WQO) for bays and estuaries, applicable at the mouth of Tecolote Creek as it flows into Mission Bay. The final wet weather TMDL based on single sample maximum REC-1 WQOs corresponds to the sum of the bar segments below the numeric target line in the final load-duration curve in Figure 7-2.
c Load allocation for Open Space sources, which are considered uncontrollable sources, exceeds the final TMDL. Therefore, no wasteload allocation is available for point sources.

Comment [s5]: Kind of confusing with billion MPN/year & billion MPN/month. Do you want me to convert the Billion MPN/year into month for consistency? If so, we'll need to update Appendix D as well.

Table 8-3. Dry Weather TMDLs for Total Coliform, Fecal Coliform and Enterococcus Expressed as an Annual and Monthly Load

Pollutant	Existing Load	TMDL[a]	TMDL with 10% Explicit MOS	Wasteload Allocations				Load Allocations	
				Municipal MS4s		Caltrans[b]		Open Space/Rec[b]	
	Billion MPN/year	Billion MPN/month	Billion MPN/year	Billion MPN/month	Percent Reduction	Billion MPN/month	Percent Reduction	Billion MPN/month	Percent Reduction
Total Coliform	126,292	264	238	238	98.1%	0	0%	0	0%
Fecal Coliform	340	53	48	48	0%	0	0%	0	0%
Enterococcus	1,936	9	8	8	95.8%	0	0%	0	0%

Abbreviations:
MOS: Margin of Safety
MPN: Most Probable Number (of bacteria colonies)
MS4s: Municipal Separate Storm Water Sewer Systems
TMDL: Total Maximum Daily Load

Notes:
a Dry weather TMDL based on 30-day geometric mean REC-1 water quality objectives (WQOs).
b Discharges from Caltrans and Open Space/Rec categories are not significant during dry weather conditions.

9 Legal Authority for TMDL Implementation Plans

This section presents the legal authority and regulatory framework used as a basis for assigning responsibilities to dischargers to implement and monitor compliance with the requirements set forth in these TMDLs. The laws and policies governing point source[11] and nonpoint source discharges are described below. A large portion of the bacteria loads generated in the watershed and discharged to Tecolote Creek and Mission Bay comes from natural, nonanthropogenic sources. These nonpoint sources are considered largely uncontrollable and therefore cannot be regulated.

Discharger accountability for attaining bacteria allocations is established in this section. The legal authority and regulatory framework is described in terms of the following:

- Controllable water quality factors;
- Regulatory background;
- Persons accountable for point source discharges; and
- Persons accountable for controllable nonpoint source discharges.

9.1 Controllable Water Quality Factors

The source analysis (section 6) found that the vast majority of bacteria are transported to impaired Tecolote Creek through wet and dry weather runoff generated from human habitation and land use practices. Much of these bacteria discharges result from controllable water quality factors which are defined as those actions, conditions, or circumstances resulting from man's activities that may influence the quality of the waters of the state and that may be reasonably controlled. These TMDLs establish wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources for these controllable discharges.

9.2 Regulatory Framework

The regulatory framework for point sources of pollution differs from the regulatory framework for nonpoint sources. The different regulatory frameworks are described in the subsections below.

9.2.1 Point Sources

CWA section 402 establishes the National Pollutant Discharge Elimination System (NPDES) program to regulate the ‘‘discharge of a pollutant,’’ other than dredged or fill materials, from a ‘‘point source’’ into ‘‘waters of the U.S.” Under section 402, discharges of pollutants to waters of the U.S. are authorized by obtaining and complying with NPDES permits. These permits commonly contain effluent limitations consisting of either Technology Based Effluent Limitations (TBELs) or Water Quality Based Effluent

[11] The term ‘‘point source’’ is defined in CWA section 502(6) to mean any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.

Limitations (WQBELs). TBELs represent the degree of control that can be achieved by point sources using various levels of pollution control technology that are defined by the USEPA for various categories of discharges and implemented on a nation-wide basis.

TBELs may not be sufficient to ensure that WQOs will be attained in receiving waters. In such cases, NPDES regulations require the San Diego Water Board to develop WQBELs that derive from and comply with all applicable WQSs. If necessary to achieve compliance with the applicable WQOs, NPDES requirements must contain WQBELs more stringent than the applicable TBELs.[12] WQBELs may be expressed as numeric effluent limitations or as BMP development, implementation and revision requirements. Numeric effluent limitations require monitoring to assess load reductions while non-numeric provisions, such as BMP programs, require progress reports on BMP implementation and efficacy, and could also require monitoring of the waste stream for conformance with a numeric wasteload allocation requiring a mass load reduction.

In California, state Waste Discharge Requirements (WDRs) for discharges of pollutants from point sources to navigable waters of the United States that implement federal NPDES regulations and CWA requirements serve in lieu of federal NPDES permits. These are referred to as "NPDES requirements". Such requirements are issued by the state pursuant to independent state authority described in California's Porter Cologne Water Quality Control Act[13] (not authority delegated by the USEPA or derived from the CWA).

Within each TMDL, a WLA is determined which is the maximum amount of a pollutant that may be contributed to a waterbody by point source discharges of the pollutant in order to attain WQOs. NPDES requirements must include conditions that are consistent with the assumptions and requirements of the WLAs. The principal regulatory means of implementing TMDLs for point source discharges regulated under these types of NPDES requirements are:

1. Dividing up and distributing the WLAs for the pollutant entering the waterbody among all the point sources that discharge the pollutant;

2. Evaluating whether the effluent limitations or conditions within the NPDES requirements are consistent with the WLAs. If not, incorporate WQBELs that are consistent with the WLAs into the NPDES requirements or otherwise revise the requirements[14] to make them consistent with the assumptions and requirements of the TMDL WLAs.[15] A time schedule to achieve compliance

[12] CWA 303 (b)(1)(c) and 40 CFR 122.44(d)(1)
[13] Division 7 of the Water Code, commencing with section 13000
[14] In the case of NPDES requirements, WQBELs may include best management practices that evidence shows are consistent with the WLAs.
[15] See federal regulations [40 CFR section 122.44(d)(1)(vii)(B)]. NPDES water quality-based effluent limitations must be consistent with the assumptions and requirements of any available TMDL wasteload allocation. The regulations do not require the WQBELs to be identical to the WLAs. The regulations leave open the possibility that the San Diego Water Board could determine that fact-specific circumstances render something other than literal incorporation of the wasteload allocation to be

should also be incorporated into the NPDES requirements in instances where the discharger is unable to immediately comply with the required wasteload reductions;

3. Mandate discharger compliance with the WLAs in accordance with the terms and conditions of the new or revised NPDES requirements;

4. Implement a monitoring and/or modeling plan designed to measure the effectiveness of the controls implementing the WLAs and the progress the waterbodies are making toward attaining WQOs; and

5. Establish criteria to measure progress toward attaining WQOs and criteria for determining whether the TMDLs or WLAs need to be revised.

Because bacteria loading within urbanized areas were largely determined to be from urban runoff discharged from MS4s, the primary mechanism for TMDL attainment will be regulation of these discharges. Mechanisms to impose regulations on these discharges are discussed in the Implementation Plan, section 11.

9.2.2 Nonpoint Sources

While laws mandating control of point source discharges are contained in the federal CWA's NPDES regulations, direct control of nonpoint source pollution is left to state programs developed under state law. Within each TMDL where nonpoint sources are determined to be significant, a LA is determined which is the maximum amount of a pollutant that may be contributed to a waterbody by "nonpoint source" discharges in order to attain WQOs. LAs for nonpoint sources are not directly enforceable under the CWA and are only enforceable to the extent they are made so by state laws and regulations. The Porter-Cologne Water Quality Control Act applies to both point and nonpoint sources of pollution and serves as the principle legal authority in California for the application and enforcement of TMDL LAs for nonpoint sources.

Although the majority of bacteria reductions in these TMDLs will take place by regulation of point source discharges, LAs have been established where wet weather nonpoint sources are significant. Wet weather bacteria loads generated from open space and open recreation areas comprise more than 12 percent of the total wet weather bacteria load. Nonpoint source discharges from natural sources (bacteria deposition from aquatic and terrestrial wildlife, and bacteria bound in soil, humic material, etc.) are considered largely uncontrollable, and therefore cannot be regulated.

---

consistent with the TMDL assumptions and requirements. The rationale for such a finding could include a trade amongst dischargers of portions of their LAs or WLAs, performance of an offset program that is approved by the San Diego Water Board, or any number of other considerations bearing on facts applicable to the circumstances of the specific discharger.

9.2.3 Bacteria Nonpoint Source Discharges

There is a small animal feeding operation at the Mesa College animal facility. Discharges from small animal facilities are regulated as nonpoint source discharges under the Waiver Policy as discussed in section 10.3.[16]

The San Diego Water Board's Waiver Policy includes conditional waivers for runoff from animal operations. Essentially, these discharges are waived from requiring WDRs provided that the conditions specified for each type of discharge are being met. If dischargers knowingly or unknowingly violate the waiver conditions, the San Diego Water Board can issue WDRs, take enforcement action, and/or establish additional LAs. If the Mesa College animal facility is determined to be a cause of impairment to Tecolote Creek and/or found to be out of compliance with the waiver conditions, then the San Diego Water Board could establish a WLA and mandate a reduction in bacteria loading, or take enforcement actions as appropriate.[17]

9.3 Persons Responsible for Point Source Discharges

Persons responsible for point source discharges of bacteria include municipal Phase I urban runoff dischargers, municipal Phase II urban runoff dischargers, and Caltrans.

9.3.1 Municipal Dischargers of Urban Runoff

Since Tecolote Creek is in an urbanized area, significant bacteria loads enter the Creek through the MS4s within the watershed. MS4 discharges are point source discharges because they are released from channelized, discrete conveyance pipe systems and outfalls. Discharges from MS4s to navigable waters of the U.S. are considered to be point source discharges and are regulated in California through the issuance of NPDES requirements. Persons owning and/or operating MS4s other than Caltrans (herein referred to as Municipal Dischargers) that discharge to Tecolote Creek, or tributaries thereto, have specific roles and responsibilities assigned to them for achieving compliance with the bacteria WLAs described in section 9.

9.3.2 Municipal Phase II Dischargers of Urban Runoff

A statewide order prescribing general NPDES requirements for discharges from small MS4s[18] regulates urban runoff not covered by the San Diego Water Board's Phase I MS4 NPDES requirements (Orders Nos. R9-2007-0001, and R9-2002-0001). This statewide order addresses smaller municipalities with a population of at least 10,000 and/or a population density of more than 1,000 people per square mile. Typical enrollees under this order include federal facilities and universities. Although there are no Municipal Phase II MS4 facilities in the San Diego Region currently enrolled under

---

[16] The Mesa College animal facility may also be regulated under a Phase II storm water requirements since it is apart of Mesa College.

[17] The Mesa College animal facility may also be regulated under a Phase II storm water requirements since it is apart of Mesa College.

[18] State Water Board Order No. 2003-0005-DWQ, NPDES General Permit No. CAS000004, *Waste Discharge Requirements for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems*.

the statewide order, the San Diego Water Board can require small MS4 facilities to enroll.

9.3.3 California Department of Transportation

Caltrans is responsible for the design, construction, maintenance, and operation of the California State Highway System, including the portion of the Interstate Highway System within the State's boundaries. The roads and highways operated by Caltrans are legally defined as MS4s and discharges of pollutants from Caltrans MS4s to waters of the U.S. constitute a point source discharge that is subject to regulation under NPDES requirements.

Discharges of storm water from the Caltrans owned right-of-ways, properties, facilities, and activities, including storm water management activities in construction, maintenance, and operation of state-owned highways are regulated under State Water Board Order No. 99-06-DWQ.[19] Runoff from highway construction projects and maintenance and operation activities can carry sediment containing bacteria and other pollutants. These discharges can contribute to exceedances of water quality objectives for bacteria indicators in Tecolote Creek. Caltrans is responsible, under the terms and conditions of Order No. 99-06-DWQ, for ensuring that its operations do not contribute to violations of water quality objectives in Tecolote Creek.

9.3.4 Publicly Owned Treatment Works

No POTWs exist in the Tecolote Creek watershed but their sewage pipes lay within the watershed boundaries. Sewage discharges to surface and groundwaters are subject to enforcement actions including fines. Typically surface spills are detected and mitigated quickly, however leaking underground sewer pipes, or sewer pipes that become cross-connected with storm water pipes, may go undetected for long periods of time. Therefore, both wet and dry weather may bring sewage in contact with MS4s and Tecolote Creek.

Bacteria levels in sewage spills from sanitary sewer systems are subject to regulation under State Water Board Order No. 2006-0003-DWQ and San Diego Water Board Order No. R9-2007-0005, which establishes waste discharge requirements prohibiting sanitary sewer overflows by sewage collection agencies. Order Nos. 2006-0003-DWQ and R9-2007-0005 replace San Diego Water Board Order No. 96-04, which had been successful at reducing the number and volume of spills and protecting water quality, the environment, and public health. While Order No. 2006-0003-DWQ prohibits sanitary overflows to surface or ground waters in general, Order No. R9-2007-0005 is more stringent and prohibits "(t)he discharge of sewage from a sanitary sewer system at any point upstream of a sewage treatment plant…"[20] Together, these orders prohibit most

---

[19] Order No. 99-06-DWQ, NPDES General Permit No. CAS000003, *National Pollutant Discharge Elimination System (NPDES) Permit Statewide Storm Water Permit and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans).*

[20] Order No. R9-2007-0005 *Waste Discharge Requirements for Sewage Collection Agencies in the San Diego Region, Section B. Prohibition 1.*

kinds of discharge, including but not limited to sewer overflows and leaking underground sewer pipes.

10 Implementation Plan

This section describes the actions necessary to implement the TMDLs in order to attain applicable WQOs for indicator bacteria in Tecolote Creek and in Mission Bay at the mouth of Tecolote Creek. The plan describes implementation responsibilities assigned to point source and nonpoint source discharges and describes the schedule and key milestones for the actions to be taken.

The goal of the Implementation Plan is to ensure that WQOs[21] for indicator bacteria for Tecolote Creek are attained and maintained throughout the waterbody and in all seasons of the year. WQOs are considered "attained" when the waterbody can be removed from the *Clean Water Act Section 303(d) List of Water Quality Limited Segments*. WQOs are considered "maintained" when, upon subsequent listing cycles, the waterbody has not returned to an impaired condition and has not been re-listed on the List. Attaining and maintaining WQOs will be accomplished in Tecolote Creek and Mission Bay at the mouth of Tecolote Creek by achieving the WLAs for point sources (MS4s) and LAs for nonpoint sources in the watershed.

10.1 Regulatory Authority for Implementation Plans

TMDL implementation plans are not currently required under federal law; however, federal policy is that TMDLs should include implementation plans. CWA section 303 authorizes the USEPA to require implementation plans for TMDLs.[22] USEPA regulations implementing section 303 do not currently require states to include implementation plans for TMDLs. USEPA regulations require states to incorporate TMDLs in the State Water Quality Management Plans (Basin Plans) along with adequate implementation measures to implement all aspects of the plan.[23] USEPA policy is that states must include implementation plans as an element of TMDL Basin Plan amendments submitted to USEPA for approval.[24]

TMDL implementation plans are required under state law. Basin plans must have a program of implementation to achieve WQOs.[25] The implementation plan must include a description of actions that are necessary to achieve the objectives, a time schedule for these actions, and a description of surveillance to determine compliance with the WQOs.[26] State law requires that a TMDL include an implementation plan since a TMDL supplements, interprets, and/or refines existing WQOs. The TMDLs, LAs, and WLAs must be incorporated into the Basin Plan.[27]

[21] 40 CFR 131.38(b)(2)
[22] 40 CFR 130
[23] 40 CFR 130.6
[24] See *Guidance for Developing TMDLs in California,* USEPA Region 9, (January 7, 2000).
[25] See Water Code section 13050(j). A "Water Quality Control Plan" or "Basin Plan" consists of a designation or establishment for the waters within a specified area of all of the following: (1) Beneficial uses to be protected, (2) Water quality objectives and (3) A program of implementation needed for achieving water quality objectives.
[26] See Water Code section 13242.
[27] See CWA section 303(e).

10.2 Implementation Plan Objectives

The specific objectives of this Implementation Plan are as follows:

1. Identify the dischargers responsible for meeting the bacteria WLAs for Tecolote Creek (no controllable LAs were identified in the Tecolote Creek watershed);

2. Establish a time schedule for meeting the WLAs. The schedule will establish interim milestones that are to be achieved until the WLAs are achieved;

3. Reissue or revise the various existing statewide and regional NPDES requirements that regulate urban runoff and other point source discharges to Tecolote Creek to implement WLAs set forth in section 8;

4. Enforce the Waiver Policy for nonpoint source (NPS) bacteria discharges;

5. Establish mechanisms to track best management practice (BMP) implementation, monitor BMP effectiveness in achieving the allocations in bacteria discharges, assess success in achieving TMDL objectives and milestones, and report on TMDL program effectiveness in attaining WQOs for indicator bacteria in Tecolote Creek and Mission Bay at the mouth of Tecolote Creek; and

6. Develop a Basin Plan amendment authorizing a reference watershed approach for implementing bacteria WQOs pursuant to Issue No. 7 on the *Prioritized List of Basin Plan Issues for Investigation from September 2004 to September 2007* adopted by the San Diego Water Board as part of the 2004 Triennial Review of the Basin Plan.

10.3 Allocations and Identification of Discharges

Allocations for discharges located in the Tecolote Creek watershed are described in Tables 8-1 thru 8-3 and are expressed as annual “loads” in terms of number of bacteria colonies per year for wet weather (billion MPN/yr) and per month for dry weather (billion MPN/month). Allocations were expressed as either WLAs for point sources, or LAs for nonpoint sources. Allocations were divided between point and nonpoint sources based on land use, as discussed in Appendix D. Persons responsible for point source discharges include Caltrans and owners and operators of MS4 systems within the Tecolote Creek watershed.

Although allocations are distributed to the identified discharges of bacteria, this does not imply that other potential sources do not exist. Any potential sources in the watershed not receiving an explicit allocation described in this Technical Report are allowed a zero discharge of bacteria to Tecolote Creek.

10.3.1 Point Source Discharges

Because bacteria loading within urbanized areas generally originate from urban runoff discharged from MS4s, the primary mechanism for TMDL attainment will be increased regulation of these discharges. Persons whose point source discharges contribute to the exceedance of WQOs for indicator bacteria will be required to meet the WLAs in their urban runoff before it is discharged from MS4s to receiving waters. Municipal Dischargers (Phase I), and small MS4 dischargers (Phase II) are responsible for reducing bacteria loads in their urban runoff prior to discharge to impaired receiving waters, or tributaries thereto, because they own or operate MS4s that contribute to the impairment of receiving waters. Caltrans must not increase bacteria in its runoff prior to discharge. These discharges are identified in and regulated by NPDES requirements prescribed in the State and San Diego Water Board orders listed in Table 10-1.

Table 10-1. State and San Diego Water Board Orders Regulating MS4 Discharges

Order Number/Short Name	Order Title
State Water Board Order No. 99-06-DWQ *Caltrans Storm Water NPDES Requirements*	*Statewide Storm Water Permit, and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans)*
San Diego Water Board Order No. R9-2007-2001 *San Diego County MS4 NPDES Requirements*	*Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District*
State Water Board Order No. 2003-0005-DWQ *Small MS4 NPDES Requirements*	*Waste Discharge Requirements for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems*

10.3.2 Nonpoint Source Discharges

Nonpoint source discharges from natural sources (bacteria deposition from aquatic and terrestrial wildlife, and bacteria bound in soil, humic material, etc.) are considered largely uncontrollable, and therefore should not be regulated. Furthermore, bacteria from these nonanthropogenic sources are unlikely to indicate the presence of human pathogens. Bacteria discharges from Open Space and Open Recreation land use areas are from mostly uncontrollable, natural sources. Discharges from these land use areas were assigned a LA, but not a load reduction. Natural sources of bacteria have been accounted for in the interim TMDLs via the reference system approach, discussed in section 3.

The only controllable nonpoint source identified in the Tecolote Creek watershed is the Mesa College animal facility.[28] Discharge from this facility must meet the conditions in the waiver for animal operations.

10.3.3 Responsible Dischargers

In this TMDL project, WLAs were calculated for point source discharges and LAs were calculated for nonpoint source discharges. Two WLAs were calculated for the Tecolote Creek watershed; one for Caltrans MS4 discharges and one for municipal and small MS4 discharges. The Tecolote Creek watershed is located within the boundaries of the City of San Diego. Located within the Tecolote Creek watershed are sites owned by the San Diego City Unified School District and Mesa Community College, which have been

[28] The Mesa College animal facility may also be regulated under a Phase II storm water requirements since it is apart of Mesa College.

identified as small MS4s. The Army National Guard Units, 40th Infantry Division is not designated in the attachment to Order No. 2003-0005-DWQ but could possibly be considered as a small MS4. Therefore, Caltrans, the City of San Diego, the San Diego Unified School District and Mesa Community College, because they own or operate MS4s within the Tecolote Creek watershed, are responsible for meeting the WLAs and required reductions, and for meeting all of the TMDL requirements.[29]

10.4 Compliance Schedule and Interim Goals for Achieving Allocations

The purpose of this TMDL project is to attain and maintain the applicable WQOs in Tecolote Creek through incremental mandated reductions of bacteria from point sources discharging to impaired waters. The requirements of this project mandate that dischargers improve water quality conditions in impaired waters by achieving load and wasteload reductions in their discharges. The bacteria TMDLs for Tecolote Creek shall be implemented in a phased approach with a monitoring component to determine the effectiveness of each phase and to guide the selection of BMPs.

10.4.1 Compliance Schedule

In establishing the compliance schedule for achieving the bacteria WLAs and LAs, the San Diego Water Board must balance the need of the dischargers for a reasonable amount of time to implement an effective bacteria load reduction program against the broad-based public interest in having water quality standards attained in the waters of the Region as soon as practicable. The public interest is best served when dischargers take all reasonable and immediately feasible actions to reduce pollutant discharges to impaired waters in the shortest possible time.

The compliance schedule (Tables 10-2 and 10-3) for implementing the wasteload and load reductions required under these TMDLs is structured in a phased manner, with 100 percent of interim wet weather reductions and 100 percent of dry weather reductions necessary for protection of the REC-1 beneficial use required 10 years after OAL approval of this TMDL Basin Plan amendment. Final wet weather reductions to attain REC-1 WQOs will be required after 20 years.

The San Diego Water Board identified a Basin Plan issue in the 2004 Triennial Review of the Basin Plan[30] to authorize a reference watershed exceedance frequency or frequencies for implementing the single sample indicator bacteria WQOs within the context of a TMDL. When this proposed amendment is incorporated into the Basin Plan, the final wet weather TMDLs, allocations and reductions will be recalculated based on an appropriate exceedance frequency or frequencies. If the recalculated wet weather reductions are similar to the interim REC-1 reductions, then final compliance will be required within 10 years of OAL approval of this TMDL rather than within 20 years. This proposed Basin Plan amendment is discussed in section 10.5.6.

---

[29] The Mesa College animal facility may also be regulated under the conditions in the waiver for animal operations.

[30] *Prioritized List of Basin Plan Issues for Investigation from September 2004 to September 2007* (Attachment 1 to Resolution No. R9-2004-0156).

Table 10-2. Dry Weather Compliance Schedule and Interim Goals for Achieving Wasteload Reductions

Compliance Year (year after OAL approval)	Required Wasteload Reduction
1	No reduction required
7	50 percent reduction required to meet Dry REC-1 WQOs for TC, FC, and ENT
10	100 percent reduction required to meet Dry REC-1 WQOs for TC, FC, and ENT

Table 10-3. Wet Weather Compliance Schedule and Interim Goals for Achieving Wasteload Reductions

Compliance Year (year after OAL approval)	Required Wasteload Reduction
1	No reduction required
7	50 percent reduction required to meet Interim Wet REC-1 WQOs for TC, FC, and ENT
10	100 percent reduction required to meet Interim Wet REC-1 WQOs for TC, FC, and ENT
20	100 percent reduction required to meet Final Wet REC-1 WQOs for TC, FC, and ENT

Dischargers are expected to plan and implement bacteria load reduction BMPs immediately with all necessary dry weather and interim wet weather bacteria load reductions being achieved within 10 years. The first six years of the compliance schedule do not require any load reductions from current conditions. These years will provide the dischargers time to identify sources, develop plans and implement enhanced and expanded BMPs capable of achieving the mandated decreases in bacteria densities in Tecolote Creek. The dischargers are not required to plan and implement final wet weather bacteria load reduction BMPs until after the San Diego Water Board has considered revising the final TMDLs using a reference system approach.

10.5 San Diego Water Board Actions

This section describes the actions that the San Diego Water Board will take to implement the TMDLs. The TMDLs will be implemented primarily by reissuing or revising the existing NPDES requirements for MS4 discharges to include water quality-based effluent limitations (WQBELs) that are consistent with the assumptions and requirements of the bacteria WLAs for MS4 discharges. The process for issuance of NPDES requirements is distinct from the TMDL process, and is described in section 10.5.1. WQBELs for municipal storm water discharges can be either numeric or non-numeric. Non-numeric WQBELs typically are a program of expanded or better-tailored BMPs. The USEPA expects that most WQBELs for NPDES-regulated municipal discharges will be in the form of BMPs, and that numeric limitations will be used only in rare instances.[31] WQBELs can be incorporated into NPDES requirements for MS4 discharges by reissuing or revising these requirements.

10.5.1 Process and Schedule for Issuing NPDES Requirements

The public process for issuing NPDES requirements is distinct but similar to the process for adopting TMDLs. For NPDES requirements, the process begins when the operator of the facility (discharger) submits a report of waste discharge (RWD) to the San Diego Water Board for review. After reviewing the RWD, the San Diego Water Board must make a decision whether or not to proceed with the NPDES requirements. Using the information and data in the RWD, the San Diego Water Board develops draft NPDES requirements and the justification for the conditions (referred to as the fact sheet).

The first major step in the development process is to develop numerical effluent limitations on the amounts of specified pollutants that may be discharged and/or specify BMPs designed to minimize water quality impacts. These numerical effluent limitations and BMPs or other non-numerical effluent limitations must implement both technology-based and water quality-based requirements of the Clean Water Act. Technology-based effluent limitations (TBELs) represent the degree of control that can be achieved by point sources using various levels of pollution control technology. If necessary to achieve compliance with applicable water quality standards, NPDES requirements must contain WQBELs, derived from the applicable receiving water quality standards, more stringent than the applicable technology-based standards. In the context of a TMDL, the WQBELs must be consistent with the assumptions and requirements of the WLAs of any applicable TMDL. Following the development of effluent limitations, the San Diego Water Board develops appropriate monitoring and reporting conditions, facility-specific special conditions, and includes standard provisions that are the same for all NPDES requirements.

After the draft NPDES requirements are complete, the San Diego Water Board provides an opportunity for public participation in the process. A public notice announces the availability of the draft requirements, and interested persons may submit comments. Based on the comments, the San Diego Water Board develops the final requirements, documenting the process and decisions in the administrative record. The final NPDES requirements are issued to the facility in an order adopted by the San Diego Water Board.

In the case of point sources, NPDES requirements should be issued, reissued, or revised “as expeditiously as practicable” to incorporate WQBELs derived from the TMDL WLAs. “As expeditiously as practicable” means the following:

1. **New Point Sources**. “New” point sources previously unregulated by NPDES requirements must obtain their NPDES requirements before they can lawfully

[31] USEPA memorandum entitled “Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs,” dated November 22, 2002.

discharge pollutants. For point sources receiving NPDES requirements for the first time, “as expeditiously as practicable” means that the San Diego Water Board incorporates WQBELs that are consistent with the assumptions and requirements of the WLAs into the NPDES requirements and requires compliance with the WQBELs upon the commencement of the discharge.

2. **Point Sources Currently Regulated Under NPDES Requirements**. For point sources currently regulated under NPDES requirements, “as expeditiously as practicable” means that:

    a. WQBELs that are consistent with the assumptions and requirements of the WLAs should be incorporated into NPDES requirements during their 5-year term, prior to expiration, in accordance with the applicable NPDES requirement reopening provisions, taking into account factors such as available NPDES resources, staff and budget constraints, and other competing priorities.

    b. In the event the NPDES requirement revisions cannot be considered during the 5-year term, the San Diego Water Board will incorporate WQBELs that are consistent with the assumptions and requirements of the WLAs into the NPDES requirements at the end of the 5-year term.

10.5.2 Actions with respect to the California Department of Transportation

Under Receiving Water Limitation C-1-3.a of State Water Board Order No. 99-06-DWQ (Caltrans Storm Water NPDES requirements), Caltrans is required to implement additional BMPs to reduce bacteria discharges in impaired watersheds to the maximum extent practicable and to restore compliance with the bacteria WQOs. This obligation is triggered when either the discharger or the SWRCB determines that MS4 discharges are causing or contributing to an exceedance of an applicable WQO, in this case indicator bacteria WQOs. Designation of Tecolote Creek as a water quality limited segment under CWA section 303(d) provided sufficient evidence that that MS4 discharges are causing or contributing to the violation of water quality standards. Thus, Caltrans should be implementing the provisions of Receiving Water Limitation C-1-3.a with respect to bacteria discharges into water quality limited segments.

The WLAs for Caltrans established in section 8 are equal to the existing load estimated from Caltrans discharges. Although Caltrans is not required to reduce discharges of bacteria from existing loading, WLAs are established so that Caltrans shall not increase its wet weather discharges above current levels. The San Diego Water Board shall request that the State Water Board enforce the provisions of Receiving Water Limitation C-1-3.a and reissue or revise Order No. 99-06, to include requirements to implement the TMDL. The requirements implementing the TMDLs shall include the following:

a. WQBELs consistent with the requirements and assumptions of the bacteria WLAs described in Tables 8-1 through 8-3 and a schedule of compliance applicable to MS4 discharges into impaired beaches and creeks, or tributaries thereto, described in Tables 10-2 and 10-3. At a minimum, WQBELs shall include a BMP program of expanded or better-tailored BMPs to attain the WLAs in accordance with the compliance schedule in Tables 10-2 and 10-3.

b. If the WQBELs consist of a BMP program, then the reporting requirements shall consist of annual progress reports on BMP planning, implementation, and effectiveness in attaining the WQOs in Tecolote Creek, and annual water quality monitoring reports. Reporting shall continue until the bacteria WQOs are attained in Tecolote Creek.

   The first progress report shall consist of a Bacteria Load Management Plan. The Bacteria Load Management Plan must include the following components:

   - Description of existing BMPs;
   - Discussion of effectiveness of existing BMPs and method(s) of evaluation;
   - Description of additional BMPs that will be utilized to meet the required waste load allocations and compliance schedule;
   - Description of locations where BMPs would be located;
   - Discussion of why these locations are appropriate; and
   - Effectiveness measures.

   The Bacteria Load Management Plan must have monitoring components that:

   - Have the capability to measure receiving water quality and assess compliance with water quality objectives;
   - Provide information showing whether or not wasteload allocations are being met;
   - Locate anthropogenic bacteria hotspots;
   - Identify and characterize anthropogenic bacteria sources;
   - Identify the number and location of sampling sites and provide justification for each; and
   - Describe the frequency of measurements, the bacteria indicators being measured, and the justification for each.

   Subsequent reports should describe the effectiveness of implementing the Bacteria Load Management Plan. Methods used for assessing effectiveness should include the following or their equivalent: surveys, pollutant loading estimations, and receiving water quality monitoring. The long-term strategy should also discuss the role of monitoring data in substantiating or refining the assessment. Once WQOs have been attained, a reduced level of monitoring may be appropriate.

In addition to these requirements, if numeric WQBELs are included in the NPDES requirements, the monitoring requirements shall include flow and bacteria density measurements to determine if bacteria loads in effluent are in compliance with WQBELS.

If NPDES requirements are not likely to be issued, reissued or revised within 6 months of OAL approval of these TMDLs, the San Diego Water Board may issue an investigative/monitoring order to Caltrans pursuant to sections 13267 or 13383 of the Water Code. This order would require submission of reports on BMP planning and receiving water quality monitoring in adherence to performance measures described above.

The Bacteria Load Management Plan may be re-evaluated at set intervals (such as 5-year renewal cycles for NPDES requirements, or upon request from dischargers, as appropriate and in accordance with San Diego Water Board priorities). Plans may be iterative and adaptive according to assessments and any special studies.

10.5.3 Actions with respect to Phase I Municipal Dischargers

California's Municipal Storm Water Program regulates storm water discharges from MS4s. NPDES requirements for MS4 discharges were issued in two phases. Under Phase I, which began in 1990, the Regional Water Boards adopted NPDES urban runoff requirements for medium (serving between 100,000 and 250,000 people) and large (serving 250,000 people) municipalities. Most of these requirements are issued to a group of municipalities ("copermittees") encompassing an entire metropolitan or county area. These requirements are issued for fixed terms of five years and are reissued upon the request of the discharger as they expire.

The Phase I Municipal Dischargers in San Diego County are required under Receiving Water Limitation C.2[32] of Order No. R9-2007-0001 (San Diego County MS4 NPDES requirements) to implement additional BMPs to reduce bacteria discharges in impaired watersheds to the maximum extent practicable and to restore compliance with the bacteria WQOs. This obligation is triggered when either the discharger or the San Diego Water Board determines that MS4 discharges are causing or contributing to an exceedance of an applicable WQO, in this case indicator bacteria WQOs. Designation of Tecolote Creek as a water quality limited segment under CWA section 303(d) provided sufficient evidence that the MS4 discharges are causing or contributing to the violation of water quality standards. Thus, the Municipal Dischargers should be

[32] Receiving Water Limitation C.2.a provides that "[u]pon a determination by either the Copermittee or the San Diego Water Board that MS4 discharges are causing or contributing to an exceedance of an applicable water quality standard, the Copermittee shall promptly notify and thereafter submit a report to the San Diego Water Board that describes BMPs that are currently being implemented and additional BMPs that will be implemented to prevent or reduce any pollutants that are causing or contributing to the exceedance of water quality standards. The report may be incorporated in the annual update to the Jurisdictional URMP unless the San Diego Water Board directs an earlier submittal. The report shall include an implementation schedule. The San Diego Water Board may require modification to the report." Additional requirements are included in sections C.2.b-d.

implementing the provisions of Receiving Water Limitation C.2 with respect to bacteria discharges into Tecolote Creek.

In addition to enforcing the provisions of Receiving Water Limitation C.2, the San Diego Water Board shall reissue or revise Order No. R9-2007-0001, to incorporate WQBELs consistent with the assumptions and requirements of the bacteria WLAs, and requirements for monitoring and reporting. In this order, the Phase I Municipal Dischargers are referred to as "copermittees."[33] WQBELs and other requirements implementing the TMDLs could be incorporated into these NPDES requirements upon the normal renewal cycle or sooner, if appropriate. The requirements implementing the TMDLs shall include the following:

a. WQBELs consistent with the requirements and assumptions of the bacteria WLAs described in Tables 8-1 through 8-3 and a schedule of compliance applicable to the MS4 discharges into Tecolote Creek, or tributaries thereto, described in Tables 10-2 and 10-3. At a minimum, WQBELs shall include a BMP program of expanded or better-tailored BMPs to attain the WLAs in accordance with the compliance schedule in Tables 10-2 and 10-3.

b. If the WQBELs consist of BMP programs, then the reporting requirements shall consist of annual progress reports on BMP planning, implementation, and effectiveness in attaining the WQOs in Tecolote Creek, in addition to annual water quality monitoring reports. Reporting shall continue until the bacteria WQOs are attained in Tecolote Creek. The first progress report shall consist of a Bacteria Load Management Plan. The Bacteria Load Management Plan must include the following components:

    - Description of existing BMPs;
    - Discussion of effectiveness of existing BMPs and method(s) of evaluation;
    - Description of additional BMPs that will be utilized to meet the required load reductions and compliance schedule;
    - Description of locations where BMPs would be located;
    - Discussion of why these locations are appropriate; and
    - Effectiveness measures.

    Bacteria Load Management Plans must have monitoring components that:

    - Have the capability to measure receiving water quality and assess compliance with WQOs;

[33] Copermittees own or operate MS4s through which urban runoff discharges into waters of the U.S. within the San Diego Region. These MS4s fall into one or more of the following categories: (1) a medium or large MS4 that services a population of greater than 100,000 or 250,000 respectively; or (2) a small MS4 that is "interrelated" to a medium or large MS4; or (3) an MS4 which contributes to a violation of a water quality standard; or (4) an MS4 which is a significant contributor of pollutants to waters of the United States.

- Provide information showing whether or not wasteload reductions are being met;
- Locate anthropogenic bacteria hotspots;
- Identify and characterize anthropogenic bacteria sources;
- Identify the number and location of sampling sites and provide justification for each; and
- Describe the frequency of measurements, the bacteria indicators being measured, and the justification for each.

Subsequent reports should describe the effectiveness of implementing the Bacteria Load Management Plan. Methods used for assessing effectiveness should include the following or their equivalent: surveys, pollutant loading estimations, and receiving water quality monitoring. The long-term strategy should also discuss the role of monitoring data in substantiating or refining the assessment. Once WQOs have been attained, a reduced level of monitoring may be appropriate.

If NPDES requirements are not likely to be issued, reissued or revised within 6 months of OAL approval of these TMDLs, the San Diego Water Board may issue an investigative/monitoring order to dischargers pursuant to sections 13267 or 13383 of the Water Code. This order would require BMP planning and receiving water quality monitoring in adherence to performance measures described above.

The Bacteria Load Management Plan may be re-evaluated at set intervals (such as 5-year renewal cycles for NPDES requirements, or upon request from named dischargers, as appropriate and in accordance with the San Diego Water Board priorities). The Plan may be iterative and adaptive according to assessments and any special studies.

10.5.4 Actions with respect to Discharges from Small MS4s

As part of Phase II of the municipal storm water program, the State Water Board adopted General NPDES requirements for the discharge of storm water from small MS4s (SWRCB Order No. 2003-0005-DWQ). This order provides NPDES requirements for smaller municipalities, including non-traditional, small MS4s, which are governmental facilities such as military bases, public campuses, and prison and hospital complexes.

Order No. 2003-0005-DWQ requires the Phase II small MS4 dischargers to develop and implement a Storm Water Management Plan/Program with the goal of reducing the discharge of pollutants to the maximum extent practicable (MEP). MEP is the performance standard specified in section 402(p) of the CWA. The management programs specify what BMPs will be used to address certain program areas. The program areas include public education and outreach; illicit discharge detection and elimination; construction and post-construction; and good housekeeping for municipal operations. In general, medium and large municipalities are required to conduct chemical monitoring, though small municipalities are not.

Order No. 2003-0005-DWQ identifies the facilities in the San Diego Region subject to regulation under the order. Currently, none of these facilities are enrolled under the general NPDES requirements.

The San Diego Water Board shall require owners and operators of small MS4s in the Tecolote Creek watershed subject to this TMDL to submit Notices of Intent[34] to comply with the requirements of Order No. 2003-0005-DWQ. These small MS4s include Mesa College and San Diego City Unified School District campuses in Tecolote Creek Watershed (as shown in Appendix G). Once enrolled under the order, small MS4 owners and operators will be required to comply with the provisions of the order to reduce the discharge of bacteria to the MEP as specified in their Storm Water Management Plans/Programs. The Army National Guard Units, 40th Infantry Division is not designated as a small MS4 in the attachment to Order No. 2003-0005-DWQ. The San Diego Water Board will further investigate this to determine whether or not to regulate this facility under the small MS4 storm water requirements.

10.5.5 Additional Actions

Additional actions that the San Diego Water Board can take to ensure implementation of these TMDLs are to take enforcement actions, and recommend high prioritization of TMDL implementation projects for grant funds as described below.

<u>Take Enforcement Actions</u>

The San Diego Water Board shall consider enforcement actions,[35] as necessary, against any discharger failing to comply with applicable waiver conditions, WDRs, discharge prohibitions, or take enforcement action, as necessary, to control the discharge of bacteria to Tecolote Creek, to attain compliance with the bacteria WLAs specified in this Technical Report, or to attain compliance with the bacteria WQOs. The San Diego Water Board may also terminate the applicability of waivers and issue WDRs or take other appropriate action against any discharger(s) failing to comply with the waiver conditions.

<u>Recommend High Priority for Grant Funds</u>

The San Diego Water Board shall recommend that the State Water Board assign a high priority to awarding grant funding[36] for projects to implement the bacteria TMDLs.

---

[34] The Notice of Intent, or NOI, is attachment 7 to Order No. 2003-0005-DWQ.

[35] An enforcement action is any formal or informal action taken to address an incidence of actual or threatened noncompliance with existing regulations or provisions designed to protect water quality. Potential enforcement actions including notices of violation (NOVs), notices to comply (NTCs), imposition of time schedules (TSO), issuance of cease and desist orders (CDOs) and cleanup and abatement orders (CAOs), administrative civil liability (ACL), and referral to the attorney general (AG) or district attorney (DA). The San Diego Water Board generally implements enforcement through an escalating series of actions to: (1) assist cooperative dischargers in achieving compliance; (2) compel compliance for repeat violations and recalcitrant violators; and (3) provide a disincentive for noncompliance.

[36] The SWRCB administers the awarding of grants funded from Proposition 13, Proposition 50, Clean Water Act section 319(h) and other federal appropriations to projects that can result in measurable

Special emphasis will be given to projects that can achieve quantifiable bacteria load reductions consistent with the specific bacteria TMDL WLAs and LAs.

10.5.6 Develop a Basin Plan Amendment Authorizing a Reference Watershed Approach for Implementing Bacteria WQOs

Issue No. 7 on the *Prioritized List of Basin Plan Issues for Investigation Between September 2004 and September 2007* includes the investigation and processing of a Basin Plan amendment to establish a reference watershed approach for interpreting the bacteria WQOs in the Basin Plan and Ocean Plan. The SCCWRP recently completed a study to characterize reference systems for bacteria in southern California. A reference system was defined in the study as a beach and upstream watershed consisting of at least 95 percent undeveloped lands. Because the reference systems consist almost entirely of undeveloped land, the bacteria washed down to the beach come from natural, nonanthropogenic sources. Measurements during the 2004 to 2005 winter season showed that in four reference systems (two in Los Angeles County, one in Orange County, and one in San Diego County), 27 percent of all samples collected within 24 hours of rainfall exceeded water quality thresholds for at least one indicator (i.e., a single sample WQO was exceeded 27 percent of the time due to nonanthropogenic sources within 24 hours of rainfall) (Schiff et al., 2005). This is higher than the 22 percent found at the Arroyo Sequit watershed in Los Angeles, which was used to calculate interim TMDLs discussed in section 3.1. The Arroyo Sequit watershed is one of the four reference watersheds included in this study.

The reference system approach is designed to account for bacteria loading from natural sources. This approach assumes that the natural processes that generate bacteria loads in a reference system, such as bacteria regrowth on beach wrack,[37] resuspension from disturbed sediment, and direct deposition of bird and mammal feces in water, also occurs in the urbanized watershed and downstream beach. The frequency of exceedance of single sample bacteria WQOs from natural sources can be measured in reference systems, and applied in urbanized watersheds. As discussed in section 3, dischargers are not required to reduce bacteria loads from these and other natural sources to achieve TMDLs.

As written, this TMDL project requires attainment of both interim TMDLs, which incorporate the reference system approach, and final TMDLs, which adhere to WQOs as currently written in the Basin Plan. A Basin Plan amendment to authorize the reference system approach for implementing single sample bacteria WQOs is required to avoid the need to attain the final TMDLs. The San Diego Water Board is developing the proposed reference system Basin Plan amendment which was released for a formal public comment period on February 29, 2008. If this Basin Plan amendment is adopted,

improvements in water quality, watershed condition, and/or capacity for effective watershed management. Many of these grant fund programs have specific set-asides for expenditures in the areas of watershed management and TMDL project implementation for non-point source pollution.

[37] Wrack consists of seaweed, eel grass, kelp, and other marine vegetation that washes up on shore and accumulates at the high tide line. The “wrack line” is essentially the high tide line.

TMDLs included in this project can be re-calculated to reflect an appropriate exceedance frequency.

10.6 Coordination and Execution of Special Studies

The San Diego Water Board recognizes that coordination and execution of special studies by dischargers and other interested persons could result in improved TMDL analyses. Areas of study that could benefit TMDL analysis include collection of data that can be used to improve model output, additional monitoring to better characterize the variability of dry weather flows and bacteria concentrations, improved understanding of bacteria levels and the relationship to health effects, and identification of an appropriate and affordable method(s) to measure pathogens directly. Additionally, studies designed to measure BMP effectiveness and bacteria source identification (including whether human waste is present in the creek; see sections 10.6.2 and 10.6.3) will be useful for dischargers in identifying appropriate strategies to meet the requirements of these TMDLs.

10.6.1 Collect Data Useful for Wet Weather Model Improvement

Calibration and verification of the computer models used for wet weather TMDL analysis was based on limited data (water quality, flow) and assumed values for input parameters such as rates for bacteria die-off and re-growth. Studies designed to collect additional data that can be used for wet weather model improvement will result in more accurate TMDL results.

10.6.2 Improve Understanding between Bacteria Levels and Health Effects

The San Diego Water Board recognizes that there are potential problems associated with using bacteria WQOs to indicate the presence of human pathogens in receiving waters free of sewage discharges. The indicator bacteria WQOs were developed, in part, based on epidemiological studies in waters with sewage inputs. The risk of contracting a water-born illness from contact with urban runoff devoid of sewage, or human-source bacteria is not known. Some pathogens, such as *giardia* and *cryptosporidium,* can be contracted from animal hosts. Likewise, domestic animals can pass on human pathogens through their feces. These and other uncertainties need to be addressed through special studies and, as a result, revisions to the TMDLs established in this project may be appropriate.

Indicator bacteria are used to measure the risk of swimmer illness because they have been shown to indicate the presence of human pathogens, such as viruses, when human bacteria sources are present. Bacterial indicators have been historically used because they are easier and less costly to measure than the pathogens themselves (see Appendix A). In recent years, however, questions have been raised regarding the validity of using indicator bacteria to ascertain risk to swimmers in recreational waters, since they appear to be less correlated to viruses when sources are from urban runoff (Jiang et al, 2001). In fact, most epidemiology studies conducted to measure the risk of swimmer illness in the presence of indicator bacteria have taken place in receiving waters containing known sewage impacts.

To date, only two epidemiology studies have been conducted where the bacteria source was primarily urban runoff. The Santa Monica Bay epidemiology study (Haile et al, 1999) reported that there was a direct correlation between swimming related illnesses and densities of indicator bacteria. The sites included in this study were known to contain human sources of fecal contamination. Most recently, the Mission Bay epidemiological study (Colford et al, 2005) showed that there was no correlation between swimmer illness and concentrations of indicator bacteria. Unlike Santa Monica Bay, bacteria sources in Mission Bay were shown to be primarily of nonhuman origin (City of San Diego and MEC/Weston Solutions Inc, 2004). The studies caution against extrapolating the results from the Mission Bay study to other locations, since there have been extensive cleanup activities on this waterbody and subsequently bacteria source analyses have shown that human fecal sources are only a minor contributor. The link between bacteria loads from urban runoff containing mostly nonhuman sources, and risk of illness needs to be better understood.

Recent studies have also shown that bacteria regrowth is a significant phenomenon (City of San Diego and MEC/Weston, 2004; City of Laguna Niguel and Kennedy Jenks, 2003). Such regrowth can cause elevations in bacteria levels that do not correspond to an increase in human pathogens and risk of illness. For example, the Mission Bay Source Identification Study found that bacteria multiply in the wrack line on the beach (eel grass and other debris) during low tide, causing exceedances of the water quality objectives during high tide when the wrack is inundated. This same phenomenon likely occurs inside storm drains, where tidal cycles and freshwater input can cause bacteria to multiply. In both these cases, an increase in bacteria densities does not necessarily correlate to an increase in the presence of human pathogens. The regrowth phenomenon is problematic since dischargers must expend significant resources to reduce the current bacteria loads to receiving waters to meet the required waste load reductions.

As information is gathered, initiating special studies to understand the uncertainties between bacteria levels and bacteria sources within the watersheds may be useful. Specifically, continuing research may be helpful to answer the following questions:

- What is the risk of illness from swimming in water contaminated with urban/storm water runoff devoid of sewage?
- Do exceedances of the bacteria WQOs from animal sources (wildlife and domestic) increase the risk of illness?
- Are there other, more appropriate surrogates for measuring the risk of illness than the indicator bacteria WQOs currently used?

Addressing these uncertainties is needed to maximize effectiveness of strategies to reduce the risk of illness, which is currently measured by indicator bacteria densities. Dischargers may work with the San Diego Water Board to determine if such special studies are appropriate. Ultimately, TMDLs will be recalculated if WQOs are modified due to results from new epidemiological studies in the future.

10.6.3 Identification of Method for Direct Pathogen Measurement

Ultimately, the San Diego Water Board supports the idea of measuring pathogens (the agents causing impairment of beneficial uses) rather than indicator bacteria (surrogates for pathogens). However, as stated previously, indicator bacteria have been used to measure water quality historically because measurement of pathogens is both difficult and costly. The San Diego Water Board is supportive of any efforts by the scientific community to perform epidemiological studies and/or investigate the feasibility of measuring pathogens directly. Ultimately, TMDLs will be recalculated if WQOs are modified due to results from future studies.

11 Necessity of Regulatory Provisions

The OAL is responsible for reviewing administrative regulations proposed by State agencies for compliance with standards set forth in California's Administrative Procedure Act, Government Code section 11340 *et seq*., for transmitting these regulations to the Secretary of State and for publishing regulations in the California Code of Regulations. Following State Water Board approval of this Basin Plan amendment establishing TMDLs, any regulatory portions of the amendment must be approved by the OAL per Government Code section 11352. The State Water Board must include in its submittal to the OAL a summary of the necessity[38] for the regulatory provision.

This Basin Plan amendment for Bacteria TMDLs for Tecolote Creek meets the "necessity standard" of Government Code section 11353(b). Amendment of the Basin Plan to establish and implement bacteria TMDLs in affected watersheds in the San Diego Region is necessary because the existing water quality does not meet applicable numeric WQOs for indicator bacteria. Applicable state and federal laws require the adoption of this Basin Plan amendment and regulations as provided below.

The State and Regional Water Boards are delegated the responsibility for implementing California's Porter Cologne Water Quality Control Act and the federal CWA. Pursuant to relevant provisions of both of those acts, the State Water Board and San Diego Water Board establish water quality standards, including designated (beneficial) uses and criteria or objectives to protect those uses.

Section 303(d) of the CWA requires the states to identify certain waters within their borders that are not attaining WQSs and to establish TMDLs for certain pollutants impairing those waters[39]. USEPA regulations provide that a TMDL is a numerical calculation of the amount of a pollutant that a water body can assimilate and still meet standards[40]. A TMDL includes one or more numeric targets that represent attainment of the applicable standards, considering seasonal variations and a MOS, in addition to the allocation of the target or load among the various sources of the pollutant. These include WLAs for point sources and LAs for nonpoint sources and natural background. TMDLs established for impaired waters must be submitted to the USEPA for approval.

CWA section 303(e) requires that TMDLs, upon USEPA approval, be incorporated into the state's Water Quality Management Plans, along with

[38] "Necessity" means the record of the rulemaking proceeding demonstrates by substantial evidence the need for a regulation to effectuate the purpose of the statute, court decision, provision of law that the regulation implements, interprets, or makes, taking into account the totality of the record. For purposes of this standard, evidence includes, but is not limited to, facts, studies, and expert opinion. [Government Code section 11349(a)].

[39] 33 USC section 1313(d)

[40] 40 CFR 130.2

adequate measures to implement all aspects of the TMDL. In California, these are the basin plans for the nine regions. Water Code sections 13050(j) and 13242 require that basin plans have a program of implementation to achieve WQOs. The implementation program must include a description of actions that are necessary to achieve the objectives, a time schedule for these actions, and a description of surveillance to determine compliance with the objectives. State law requires that a TMDL project include an implementation plan because TMDLs normally are, in essence, interpretations or refinements of existing WQOs. The TMDLs have to be incorporated into the Basin Plan and, because the TMDLs supplement, interpret, or refine existing objectives, State law requires a program of implementation.[41]

[41] CWA section 303(e)

12 Public Participation

Public participation is an important component of TMDL development. The federal regulations require that TMDL projects be subject to public review.[42] All public hearings and public meetings have been conducted as stipulated in the regulations, for all programs under the CWA.[43] Public participation was provided through public workshops, and through the formation and participation of the Stakeholder Advisory Group (SAG). In addition, staff contact information was provided on the San Diego Water Board's website, along with periodically updated drafts of the TMDL project documents. Public participation also took place through the San Diego Water Board's Basin Plan amendment process, which included a hearing and a formal public comment period. A chronology of public participation and major milestones is provided in Table 12-1.

Table 12-1. Public Participation Milestones

Date	Event
June 8, 2006	Public Workshop and CEQA Scoping Meeting
October 3, 2006	SAG Meeting
January 8, 2008	SAG Meeting
April 25, 2008	Draft Documents released for public review
June 11, 2008	Public Hearing

[42] 40 CFR 130.7
[43] 40 CFR 25.5 and 25.6

13 References

Ackerman, D., K. Schiff, and S. Weisberg. 2005. Evaluating HSPF in an Arid, Urban Watershed. *Journal of the American Water Resources Association*, 41(2): 477-486.

Ackerman, D. and S. Weisberg. 2003. Relationship between rainfall and beach bacterial concentrations on Santa Monica Bay beaches. *Journal of Water and Health* 1: 85-89.

Bicknell, B.R., J.C. Imhoff, J.L. Kittle, A.S. Donigian, and R.C. Johanson. 1996. *Hydrological Simulation Program – FORTRAN (HSPF): User's Manual Release 12*. National Exposure Research Laboratory, Office of Research and Development, USEPA, Athens, Georgia.

City of Laguna Niguel and Kennedy /Jenks Consultants. 2003. *Report on Water Quality Fecal Contamination Testing—Draft Final Report*. Laguna Niguel, CA.

City of San Diego and MEC/Weston. 2004. *Mission Bay Clean Beaches Initiative Bacterial Source Identification Study*. City of San Diego and MEC Analytical Systems- Weston Solutions, Inc., San Diego California. Prepared for the State Water Resources Control Board, Sacramento, CA.

Colford, M.J., T.J. Wade, K.C. Schiff, C.C. Wright, J.F. Griffith, S.K. Sandhu, S.B. Weisberg. 2005. *Recreational water contact and illness in Mission Bay, CA*. Southern California Coastal Water Research Project Technical Report No. 449. Southern California Coastal Water Research Project, Westminster, CA.

County of San Diego Department of Environmental Health. 2000. County of San Diego—Ocean Illness Survey Results (August 1997–December 1999).

County of San Diego. 2005. *San Diego County Municipal Copermittees 2004-2005 Urban Runoff Monitoring – Final Report*. Report prepared for the County of San Diego by Weston Solutions, Inc., Carlsbad, CA.

Haile, R.W., J.S. Witte, M. Gold, R. Cressey, C. McGee, R.C. Millikan, A. Glasser, N. Harawa, C. Ervin, P. Harmon, J. Harper, J. Dermand, J. Alamillo, K. Barrett, M. Nides and G.-Y. Wang. 1999. The health effects of swimming in ocean water contaminated by storm drain runoff. *Epidemiology* 10:355-363.

Holden, P.A. 2007. Personal communication on March 5, 2007. Scientific Peer Review of the Technical Dry Weather TMDL Analysis Portion of the Amendment Incorporating the Total Maximum Daily Loads for Indicator Bacteria in Tecolote Creek, Tributary to Mission Bay into the Water Quality Control Plan for the San Diego Basin.

Jiang, S., R. Noble and W. Chu. 2001.Human Adenoviruses and Coliphages in Urban Runoff-Impacted Coastal Waters of Southern California. *Applied and Environmental Microbiology* 67:1:179-184.

Los Angeles Water Board (Los Angeles Regional Water Quality Control Board). 2002. *Total Maximum Daily Load to Reduce Bacterial Indicator Densities at Santa Monica Bay Beaches during Wet Weather*. Los Angeles Regional Water Quality Control Board, Los Angeles, CA.

Los Angeles Water Board. 2003. *Total Maximum Daily Loads for Bacteria in the Malibu Creek Watershed*. California Regional Water Quality Control Board, Los Angeles Region, Los Angeles, CA.

Los Angeles Water Board. 2005a. *Total Maximum Daily Load for Metals in Ballona Creek*. Los Angeles Regional Water Quality Control Board, Los Angeles, CA.

Los Angeles Water Board. 2005b. *Total Maximum Daily Load for Metals – Los Angeles River and Tributaries*. Los Angeles Regional Water Quality Control Board, Los Angeles, CA.

San Diego Water Board (San Diego Regional Water Quality Control Boardn). 1994. *Water Quality Control Plan for the San Diego Basin (9)*. California Regional Water Quality Control Board, San Diego Region, San Diego, CA.

San Diego Water Board. 2007. *Total Maximum Daily Loads for Indicator Bacteria Project I – Beaches and Creeks in the San Diego Region – Final Technical Report*. December 12, 2007. San Diego Regional Water Quality Control Board, San Diego, CA.

SAWPA (Santa Ana Watershed Project Authority). 2003. *Lake Elsinore and Canyon Lake Nutrient Source Assessment – Final Report*. Report prepared by Tetra Tech, Inc., San Diego, CA.

Schiff, K., J. Griffith, and Gregory Lyon. 2005. *Microbial Water Quality at Reference Beaches in Southern California During Wet Weather*. Southern California Coastal Water Research Project Technical Report # 448. Southern California Coastal Water Research Project, Westminster, CA.

Shen, J., A. Parker, and J. Riverson. 2004. A New Approach for a Windows-based Watershed Modeling System Based on a Database-supporting Architecture. *Environmental Modeling and Software*, July 2004.

Soil Conservation Service. 1986. *Urban Hydrology of Small Watersheds, Technical Release 55*. United States Department of Agriculture.

Tetra Tech, Inc, 2005a. *Model Development for Simulation of Wet-Weather Metals Loading from the San Gabriel River Watershed*. Report prepared for USEPA Region 9 and the Los Angeles Regional Water Quality Control Board by Tetra Tech, Inc, San Diego, CA.

Tetra Tech, Inc. 2005b. *Model Development for Simulation of Indicator Bacteria in the San Jacinto Watershed and Canyon Lake – Final Report*. Report prepared for USEPA Region 9 and the Santa Ana Regional Water Quality Control Board by Tetra Tech, Inc., San Diego, CA.

U.S. Environmental Protection Agency (USEPA). 1986. *Ambient Water Quality Criteria for Bacteria – 1986*. EPA440/5-84-002. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Criteria and Standards Division. Washington, D.C.

USEPA. 1991. *Guidance for Water Quality-Based Decisions: The TMDL Process*. EPA 440/4-91-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA. 2003a. *Fact Sheet: Loading Simulation Program in C++*. USEPA, Watershed and Water Quality Modeling Technical Support Center, Athens, GA. Available at http://www.epa.gov/athens/wwqtsc/LSPC.pdf (accessed in March 2006).

USEPA. 2003b. *Fact Sheet: Overview of the TMDL Toolbox*. USEPA, Watershed and Water Quality Modeling Technical Support Center, Athens, GA. Available at http://www.epa.gov/athens/wwqtsc/Toolbox-overview.pdf (accessed in March 2006).